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(54) Title: REPRODUCTION-SPECIFIC GENES

(57) Abstract: Reproduction-specific nucleic acid molecules, particularly those that are indicative of or associated with infertility in men, proteins encoded by these reproduction-specific nucleic acid molecules and antibodies that bind such proteins are described. Also described are variant reproduction-specific genes and proteins, and antibodies which bind such proteins, as well as methods of using the reproduction-specific genes, proteins and antibodies and methods of using the variant reproduction-specific genes, proteins and antibodies.

REPRODUCTION-SPECIFIC GENES

RELATED APPLICATION

This application claims the benefit of U.S. provisional application Serial No. 60/187,518, filed on March 7, 2000, and U.S. provisional application Serial No. 60/261,557, filed on January 12, 2001. The entire teachings of the above applications are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Infertility is of great clinical significance, and between 2 and 7% of couples are infertile. Both physical and genetic factors are associated with male infertility. Some genetic factors are chromosomal aberrations, including: chromosomal translocations, Down's syndrome, Klinefilter's syndrome and Y chromosome microdeletions. Many cases of azoospermia are idiopathic (have no obvious cause) in that the subject is infertile but otherwise healthy. Previous research has suggested that genetic factors are important contributors to these cases, but these factors have not been identified.

SUMMARY OF THE INVENTION

Spermatogonial stem cells are designated as undifferentiated spermatogonia; they are capable of self-renewal and persist as a constant population in adults. While renewing themselves, some of these stem cells begin to differentiate to give rise to type A spermatogonia. Type A spermatogonia divide four times and differentiate to eventually become type B spermatogonia. Type B spermatogonia divide once, enter meiosis at puberty, and eventually become mature sperm.

Described herein are novel nucleic acid molecules, referred to as reproduction-specific nucleic acid molecules, from spermatogonia (the stem cells of male germ cells); novel reproduction-specific proteins; antibodies that bind the

proteins; and uses of the nucleic acid molecules or portions thereof, proteins and antibodies. The novel nucleic acid molecules of the present invention fall into three classes: 1) male germ cell-specific nucleic acid molecules, which are nucleic acid molecules that are expressed only in male germ cells; 2) testis-specific nucleic acid molecules, which are nucleic acid molecules that are expressed only in testis; and 3) testis-and ovary-specific nucleic acid molecules, which are nucleic acid molecules that are only expressed in testis and ovary. As further described herein, the present work has resulted in identification of a number of variants of the testis-specific genes, TAF2Q and TEX11 which are present on sex chromosome X.

The present invention also relates to variant forms of reproduction-specific nucleic acid molecules (referred to as variant reproduction-specific nucleic acid molecules) that are indicative of or associated with infertility in men, proteins encoded by variant reproduction-specific nucleic acid molecules (referred to as variant reproduction-specific proteins), antibodies that bind such proteins, and methods of using the variant reproduction-specific nucleic acid molecules or portions thereof, proteins encoded by variant reproduction-specific nucleic acid molecules, and antibodies that bind variant reproduction-specific proteins.

The present invention encompasses all of these nucleic acid molecules, their complements, portions of the nucleic acid molecules and their complements, and any nucleic acid molecules that, through the degeneracy of the genetic code, encode a protein whose sequence is presented herein or a protein encoded by nucleic acid molecules whose sequence is specifically presented herein. Nucleic acid molecules of the present invention (genes, genomic sequences, cDNAs and portions of the foregoing) are useful, for example, as hybridization probes and as primers for amplification methods which, in turn, are useful in methods of detecting the presence, absence or alteration of the nucleic acid molecules described herein.

The present invention also relates to methods of identifying or determining differences in one or more of these reproduction-specific nucleic acid molecules that are associated with (indicative of) infertility in men. For example, nucleic acid molecules from tissues or body fluids, such as nucleic acid molecules in blood, obtained from one or more males with a known condition, such as lack of sperm

production or reduced sperm count, can be assessed, using the nucleic acid molecule(s) described herein, or characteristic portions thereof, to determine whether the male(s) lacks some or all of the nucleic acid molecule(s) described herein or has a variant nucleic acid molecule(s) (e.g., in which there is a deletion, substitution, addition or mutation, compared to the sequences presented herein). Nucleic acid molecules (e.g., from a male with reduced sperm count or viability) can be assessed, using nucleic acid molecules described herein or nucleic acid molecules which hybridize to a nucleic acid molecule described herein, to determine whether they are associated with or causative for infertility (e.g., reduced sperm count or viability). For example, the presence or absence of all or a portion of a nucleic acid molecule or nucleic acid molecules shown to be necessary for fertility or adequate sperm count can be assessed, using nucleic acid molecules which hybridize to the nucleic acid molecule or nucleic acid molecules of interest to determine the basis for an individual's infertility or reduced sperm count. In one embodiment, the occurrence of one or more reproduction-specific nucleic acid molecules or a characteristic portion of one or more reproduction-specific nucleic acid molecules is assessed in a sample containing nucleic acid molecules.

In another embodiment, deletion or alteration of one of the nucleic acid molecules described herein or a characteristic portion thereof is used to assess a nucleic acid sample obtained from a male who has a reduced sperm count or spermatogenic failure. Lack of hybridization of reproduction-specific nucleic acid molecules known to be present in fertile men, but not in infertile men, to nucleic acid molecules in the sample (sample nucleic acid molecules) indicates that the gene is not present in the sample nucleic acid molecules or is present in a variant form which does not hybridize to reproduction-specific nucleic acid molecules present in fertile men. In the present methods, sample nucleic acid molecule can be analyzed for the alteration or occurrence of one or more of the reproduction-specific nucleic acid molecules and can be analyzed for one or more of the three classes of nucleic acid molecules described herein. For example, a group of nucleic acid molecule probes (sequences) can be used to analyze sample nucleic acid molecule; the set of probes can include nucleic acid molecule probes which hybridize to two or more

reproduction-specific nucleic acid molecules or nucleic acid molecule probes which hybridize only to variant nucleic acid molecules characteristic of (indicative of) infertility in men.

Nucleic acid molecules described herein are also useful as primers in an amplification method, such as PCR, useful for identifying and amplifying reproduction-specific nucleic acid molecules in a sample (e.g., blood). Further, proteins or peptides encoded by a reproduction-specific nucleic acid molecule can be assessed in samples. This can be carried out, for example, using antibodies which recognize proteins or peptides of the present invention (proteins or peptides encoded by nucleic acid molecules described herein or a variant thereof that is present in infertile men, but not in fertile men or vice versa).

The present invention also relates to methods of diagnosing or aiding in the diagnosis of infertility in men, based on differences present in at least one of these nucleic acid molecules (between infertile men and fertile men). For example, one embodiment of this invention is a diagnostic method, such as a method of determining whether nucleic acid molecules from a man (e.g., obtained from blood, other tissue) contain at least one nucleic acid molecule which varies (comprises a substitution, deletion, addition or rearrangement) from reproduction-specific nucleic acid molecules in a manner shown to be indicative of or characteristic of infertility

The present invention further relates to proteins disclosed herein or encoded by nucleic acid molecules described herein, portions of the proteins (such as characteristic portions, referred to as characteristic peptides, useful in distinguishing between infertile and fertile men) and antibodies (monoclonal or polyclonal) that bind proteins of the present invention or characteristic portions thereof. The proteins of the present invention include proteins encoded by nucleic acid molecules whose sequence is disclosed herein; proteins whose amino acid sequences are disclosed herein; and proteins whose amino acid sequence differs from the amino acid sequence of proteins disclosed herein by at least one (one or more) residue and are associated with or indicative of azoospermia (lack of or reduction in sperm production), referred to as variant reproduction-specific proteins. Antibodies of the

present invention are useful in methods of diagnosing or aiding in the diagnosis of infertility in men.

A further subject of the present invention is a method of contraception in which sperm production and/or function are altered, preferably reversibly. In the method, the function of one or more of the nucleic acid molecules or one or more of the proteins described herein is disrupted in a man, with the result that sperm production does not occur; occurs only to a limited extent (an extent less than normally occurs in the individual); or is otherwise altered (e.g., defective sperm, such as sperm with decreased motility or shortened lifespan, are produced). For example, a reproduction-specific gene shown to be present in fertile men, but not in infertile men, is targeted and its function (expression) is disrupted, with the result that the gene is not expressed, is expressed at a reduced level (at a level lower than if it the gene function had not been disrupted) or, when it is expressed, the resulting product is defective. Alternatively, a protein or proteins encoded by a reproduction-cell specific gene(s) is targeted and its function is disrupted and/or the protein is broken down (e.g., by proteolysis). Agents (drugs) useful in the method are also the subject of the present invention.

Further, the present invention relates to a method of treating reduced sperm count, reduced sperm function, reduced sperm motility or spermatogenic failure. In one embodiment, reduced sperm count is increased by administering an agent that enhances the activity, of a reproduction-specific gene or genes. Preferably, such drugs target (act essentially exclusively upon) a reproduction-specific gene or portion thereof. Such drugs can be administered by a variety of routes, such as oral or intravenous administration. In another embodiment, a gene therapy method is used. For example, a one or more nucleic acid molecule(s) described herein, or a portion thereof which encodes a functional protein, is introduced into a man whose sperm count is reduced and in whom the nucleic acid molecule is expressed, and the resulting protein replaces or supplements the protein normally produced or enhances the quantity produced.

The nucleic acid molecules, proteins and antibodies that bind proteins of the present invention, or portions thereof, are also useful as markers for spermatogonial cells.

As described herein, particular variants of the testis-specific X-linked TAF2Q and TEX11 nucleic acid molecules from infertile men were identified by methods described herein. These variants result from alternation in the nucleic acid molecule; some nucleic acid molecules alterations are silent (do not result in a change in amino acid), while others result in an amino acid alteration or in truncation of the encoded protein. These variants are associated with male infertility. The particular variants are useful in the methods described herein and are shown in Figures 107, 108, 111 and 112.

Thus, the invention relates to an isolated reproduction-specific nucleic acid molecule comprising a nucleic acid molecule having a nucleotide sequence selected from the group consisting of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89; and the complements thereof.

The invention also relates to an isolated reproduction-specific nucleic acid molecule comprising a portion of a nucleic acid molecule having a nucleotide sequence selected from the group consisting of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89; and the complements thereof, wherein said portion is at least 14 contiguous nucleotides in length.

The invention further relates to an isolated reproduction-specific nucleic acid molecule comprising a nucleic acid molecule which hybridizes under high stringency hybridization conditions to a nucleic acid molecule having a nucleotide sequence selected from the group consisting of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89; and the complements thereof.

The invention also relates to an isolated reproduction-specific nucleic acid molecule comprising a nucleic acid molecule having a nucleotide sequence which is at least 70% identical to a nucleotide sequence selected from the group consisting of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89; and the complements thereof.

The invention further relates to an isolated reproduction-specific nucleic acid molecule which encodes a protein having an amino acid sequence selected from the group consisting of SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 51, 53, 57, 60, 63, 65, 68, 70, 72, 76, 78, 80, 82, 84, 85, 88, and 90.

The invention further relates to an isolated variant reproduction-specific nucleic acid molecule comprising a nucleic acid molecule having the nucleic acid sequence of SEQ ID NO: 89 having one or more alterations selected from the group consisting of A320G, T325A, C381T, G400A, A491G, G1282A, C1449A, T2219C, A2250T, T2295C and T2472C. The invention also relates to an isolated variant reproduction-specific nucleic acid molecule comprising a nucleic acid molecule having the nucleic acid sequence of SEQ ID NO: 50 having one or more alterations selected from the group consisting of the alterations shown in Figure 112.

The invention also relates to nucleic acid constructs comprising an isolated reproduction-specific nucleic acid molecule according to the invention operably linked to at least one regulatory sequence, and to a host cell comprising such nucleic acid constructs.

The invention also relates to an isolated protein comprising an amino acid sequence selected from the group consisting of SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 51, 53, 57, 60, 63, 65, 68, 70, 72, 76, 78, 80, 82, 84, 85, 88, and 90. The invention also pertains to an isolated protein comprising a portion of an amino acid sequence selected from the group consisting of SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 51, 53, 57, 60, 63, 65, 68, 70, 72, 76, 78, 80, 82, 84, 85, 88, and 90, wherein said portion is at least 7 contiguous amino acids.

The invention is also drawn to an isolated protein comprising the amino acid sequence of SEQ ID NO: 90 having one or more alterations selected from the group consisting of W109R, V134I, G164R, N483K and V740A. The invention also relates to an isolated protein encoded by a nucleic acid molecule according to the invention. The invention further relates to an antibody which specifically binds a protein according to the invention.

The invention also relates to a method of diagnosing infertility associated with alteration of a gene having a nucleotide sequence selected from the group consisting of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89, and whose alteration is associated with infertility, comprising the steps of: (a) obtaining a DNA sample to be assessed; (b) processing the DNA sample such that the DNA is available for hybridization; (c) combining the DNA of step (b) with nucleotide sequences complementary to the altered nucleotide sequence of said gene, whose alteration is associated with infertility, under conditions appropriate for hybridization of the probes with complementary nucleotide sequences in the DNA sample, thereby producing a combination; and (d) detecting hybridization in the combination, wherein presence of hybridization in the combination is indicative of infertility associated with an alteration of said gene.

The invention also relates to a method of diagnosing infertility associated with alteration of a gene having a nucleotide sequence selected from the group consisting of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89, and whose alteration is associated with infertility, comprising the steps of: (a) obtaining a DNA sample to be assessed; (b) processing the DNA sample such that the DNA is available for hybridization; (c) combining the DNA of step (b) with nucleotide sequences complementary to the nucleotide sequence of said gene, whose alteration is associated with infertility, under conditions appropriate for hybridization of the probes with complementary nucleotide sequences in the DNA sample, thereby producing a combination; and (d)

detecting hybridization in the combination, wherein absence of hybridization in the combination is indicative of infertility associated with an alteration of said gene. In a preferred embodiment, infertility is a result of reduced sperm count, reduced sperm motility, malformed sperm, or combinations thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 shows the Spg1 cDNA sequence.

Figure 2 shows the Spg1 encoded protein sequence.

Figures 3a-3c show the Spg2 cDNA sequence.

Figure 4 shows the Spg2 encoded protein sequence.

Figures 5a-5b show the Spg3 cDNA sequence.

Figure 6 shows the Spg3 encoded protein sequence.

Figures 7a-7d show the Spg5 cDNA sequence.

Figures 8a-8b show the Spg5 encoded protein sequence.

Figures 9a-9b show the Spg13 cDNA sequence.

Figure 10 shows the Spg13 encoded protein sequence.

Figures 11a-11b show the Spg14 cDNA sequence.

Figures 12a-12b show the Spg14 encoded protein sequence.

Figures 13a-13b show the Spg15 cDNA sequence.

Figures 14a-14b show the Spg15 encoded protein sequence.

Figures 15a-15b show the Spg16 cDNA sequence.

Figure 16 shows the Spg16 encoded protein sequence.

Figures17a-17b show the Spg17 cDNA sequence.

Figure 18 shows the Spg17 encoded protein sequence.

Figure 19 shows the Spg18 cDNA sequence

Figure 20 shows the Spg18 encoded protein sequence.

Figures 21a-21b show the Spg25 cDNA sequence.

Figures 22a-22b show the Spg25 encoded protein sequence.

Figure 23 shows the Spg27 cDNA sequence.

Figure 24 shows the Spg27 encoded protein sequence.

Figures 25a-25b show the Spg33 cDNA sequence.

Figure 26 shows the Spg33 encoded protein sequence.

Figure 27 shows the Spg34 cDNA sequence.

Figure 28 shows the Spg34 encoded protein sequence.

Figures 29a-29b show the Spg39 cDNA sequence.

Figure 30 shows the Spg39 encoded protein sequence.

Figures 31a-31b show the Spg46 cDNA sequence.

Figures 32a-32b show the Spg46 encoded protein sequence.

Figures 33a-33b show the Spg58 cDNA sequence.

Figures 34a-34b show the Spg58 encoded protein sequence.

Figure 35 shows the Spg59 cDNA sequence.

Figure 36 shows the Spg59 encoded protein sequence

Figures 37a-37b show the Spg64 cDNA sequence.

Figure 38 shows the Spg64 encoded protein sequence.

Figures 39a-39b show the Spg65 cDNA sequence.

Figure 40 shows the Spg65 encoded protein sequence.

Figures 41a-41b show the Spg69 cDNA sequence.

Figure 42 shows the Spg69 encoded protein sequence.

Figures 43a-43b show the Spg70 cDNA sequence.

Figure 44 shows the Spg70 encoded protein sequence.

Figures 45a-45c show the Spg85 cDNA sequence.

figure 46 shows the Spg85 encoded protein sequence.

Figures 47a-47b show the Spg87 cDNA sequence.

Figure 48 shows the Spg87 encoded protein sequence.

Figures 49 shows the Spg84 cDNA sequence.

Figure 50 shows the hSPG1 cDNA sequence.

Figure 51 shows the hSPG1 encoded protein sequence.

Figures 52a-52b show the hSPG3a cDNA sequence.

Figure 53 shows the hSPG3a encoded protein sequence.

Figures 54a-54e show the hSPG3a genomic DNA sequence.

Figure 55 shows the hSPG3b cDNA sequence.

Figures 56a-56d show the hSPG5 cDNA sequence.

Figures 57a-57b show the hSPG5 encoded protein sequence.

Figures 58a-58e show the hSPG5 genomic DNA sequence.

Figures 59a-59c show the hSPG15 cDNA sequence.

Figure 60 shows the hSPG15 encoded protein sequence.

Figures 61a-61t show the hSPG15 genomic DNA sequence.

Figure 62 shows the hSPG18 cDNA sequence.

Figures 63a-63b show the hSPG18 encoded protein sequence.

Figures 64a-64b show the hSPG25 cDNA sequence.

Figure 65 shows the hSPG25 encoded protein sequence.

Figure 66 shows the hSPG27 cDNA sequence.

Figures 67a-67b show the hSPG34a cDNA sequence.

Figure 68 shows the hSPG34a encoded protein sequence.

Figure 69 shows the hSPG34b cDNA sequence.

Figure 70 shows the hSPG34b encoded protein sequence.

Figures 71a-71b show the hSPG39a cDNA sequence.

Figure 72 shows the hSPG39a encoded protein sequence.

Figure 73a and 73b show the hSPG39a genomic DNA sequence.

Figure 74 shows the hSPG39b cDNA sequence.

Figures 75a-75b show the hSPG46 cDNA sequence.

Figures 76a-76b show the hSPG46 encoded protein sequence.

Figures 77 shows the hSPG64 cDNA sequence.

Figures 78a-78b show the hSPG64 encoded protein sequence.

Figures 79a-79b show the hSPG85 cDNA sequence.

Figure 80 shows the hSPG85 encoded protein sequence.

Figures 81a-81b show the hSPG13 cDNA long form sequence.

Figure 82 shows the sequence of the protein encoded by hSPG13 long form.

Figures 83a-83b show is the hSPG13 cDNA short form sequence.

Figure 84 shows the sequence of the protein encoded by hSPG13 short form.

Figure 85 shows the hSPG39b encoded protein sequence.

Figures 86a-86b show the hSPG39b genomic DNA sequence.

Figures 87a-87b show the hSPG70 cDNA sequence.

Figure 88 shows the hSPG70 encoded protein sequence.

Figures 89a and 89b show the nucleic acid sequence of TEX11 (SEQ ID NO: 89).

Figure 90 shows the amino acid sequence of TEX11 (SEQ ID NO: 90).

Figure 91 depicts the identification of spermatogonia-specific genes by cDNA subtraction.

Figure 92 depicts the known germ cell-specific genes enriched by subtraction.

Figure 93 depicts the genes identified by the subtraction.

Figure 94 depicts the novel mouse germ cell specific genes identified by subtraction.

Figure 95depicts the post-transcriptional gene regulation of germ cell development.

Figure 96 depicts the abundance of male germ-cell-specific genes on X Chromosome.

Figure 97 depicts the rapid evolution of spermatogonia-specific genes in mouse and human.

Figure 98 depicts hybrid male sterility in mice.

Figure 99 depicts candidate genes for *Hst-3*.

Figure 100 depicts the 14 novel human testis-specific genes.

Figure 101 depicts the BAC physical map and gene structure of TEX11.

Figure 102 depicts the high throughput mutation screening by genomic sequencing.

Figure 103 depicts the mutations found in infertile but not fertile males

Figure 104 depicts the clustering of mutations in 3' but not 5' regions of introns of TEX11.

Figure 105 depicts the epigenetic down regulation of X-linked genes during male meiosis.

Figure 106 depicts the abundance of spermatogonia genes on the X Chromosomes.

Figure 107 depicts the intronic variants in TEX11.

Figure 108 depicts the coding variants in TEX11.

Figure 109 is a pedigree chart of WHT3759 depicting infertility as a result of mutations in TEX11.

Figure 110 depicts the coding variants found in infertile but not fertile males.

Figure 111 is a pedigree chart of WHT2508 depicting a mutation in TAF2Q resulting in infertility.

Figure 112 depicts the variants in TAF2Q.

Figures 113a,113b and 113c depict the twenty-three spermatogonially expressed, germ cell specific genes in mouse and their humun orthologs.

DETAILED DESCRIPTION OF THE INVENTION

A description of preferred embodiments of the invention follows.

Described herein are isolated reproduction-specific nucleic acid molecules which are male germ cell-specific, testis-specific or testis-and ovary-specific. Also described are portions of the reproduction-specific nucleic acid molecules; complements of the reproduction-specific nucleic acid molecules and portions thereof and; nucleic acid molecules which hybridize to any of the reproduction-specific nucleic acid molecules under conditions of high stringency. Also described are nucleic acid molecules which are at least 70% identical in sequence to a reproduction-specific nucleic acid molecule whose sequence is presented herein or to a nucleic acid molecule which encodes a reproduction-specific protein whose amino acid sequence is presented herein, or to a nucleic acid molecule which hybridizes to any of the reproduction-specific nucleic acid molecules under conditions of high stringency.

Particularly preferred are nucleic acid molecules and portion thereof which have at least about 60%, preferably at least about 70, 80 or 85%, more preferably at least about 90%, even more preferably at least about 95%, and most preferably at least about 98% identity with nucleic acid molecules described herein.

In one embodiment, the nucleic acid molecules hybridize under high stringency hybridization conditions (*e.g.*, for selective hybridization) to a nucleotide sequence described herein.

Stringent hybridization conditions for nucleic acid molecules are well known to those skilled in the art and can be found in standard texts such as *Current Protocols in Molecular Biology*, John Wiley & Sons, N.Y. (1998), pp. 2.10.1-2.10.16 and 6.3.1-6.3.6, the teachings of which are hereby incorporated by reference. As understood by those of ordinary skill, the exact conditions can be determined empirically and depend on ionic strength, temperature and the concentration of destabilizing agents such as formamide or denaturing agents such as SDS. Other factors considered in determining the desired hybridization conditions include the length of the nucleic acid sequences, base composition, percent mismatch between the hybridizing sequences and the frequency of occurrence of subsets of the sequences within other non-identical sequences. In one non-limiting example, nucleic acid molecules are allowed to hybridize in 6X sodium chloride/sodium citrate (SSC) at about 45°C, followed by one or more low stringency washes in 0.2X SSC/0.1% SDS at room temperature, or by one or more moderate stringency washes in 0.2X SSC/0.1% SDS at 42°C, or washed in 0.2X SSC/0.1% SDS at 65°C for high stringency. Thus, equivalent conditions can be determined by varying one or more of these parameters while maintaining a similar degree of identity or similarity between the two nucleic acid molecules. Typically, conditions are used such that sequences at least about 60%, at least about 70%, at least about 80%, at least about 90% or at least about 95% or more identical to each other remain hybridized to one another.

The percent identity of two nucleotide or amino acid sequences can be determined by aligning the sequences for optimal comparison purposes (*e.g.*, gaps can be introduced in the sequence of a first sequence). The nucleotides or amino acids at corresponding positions are then compared, and the percent identity between the two sequences is a function of the number of identical positions shared by the sequences (*i.e.*, % identity = # of identical positions/total # of positions x 100). In certain embodiments, the length of a sequence aligned for comparison purposes is at least 30%, preferably at least 40%, more preferably at least 60%, and even more preferably at least 70%, 80% or 90% of the length of the reference sequence. The actual comparison of the two sequences can be accomplished by well-known

methods, for example, using a mathematical algorithm. A non-limiting example of such a mathematical algorithm is described in Karlin *et al.*, *Proc. Natl. Acad. Sci. USA, 90*:5873-5877 (1993). Such an algorithm is incorporated into the NBLAST and XBLAST programs (version 2.0) as described in Altschul *et al.*, *Nucleic Acids Res., 25*:389-3402 (1997). When utilizing BLAST and Gapped BLAST programs, the default parameters of the respective programs (*e.g.*, NBLAST) can be used. See http://www.ncbi.nlm.nih.gov. In one embodiment, parameters for sequence comparison can be set at score=100, wordlength=12, or can be varied (*e.g.*, W=5 or W=20).

A mathematical algorithm utilized for the comparison of sequences is the algorithm of Myers and Miller, CABIOS (1989). Such an algorithm is incorporated into the ALIGN program (version 2.0) which is part of the CGC sequence alignment software package. When utilizing the ALIGN program for comparing amino acid sequences, a PAM120 weight residue table, a gap length penalty of 12 , and a gap penalty of 4 can be used. Additional algorithms for sequence analysis are known in the art and include ADVANCE and ADAM as described in Torellis and Robotti (1994) *Comput. Appl. Biosci., 10*:3-5; and FASTA described in Pearson and Lipman (1988) *PNAS, 85*:2444-8.

The percent identity between two amino acid sequences can be accomplished using the GAP program in the CGC software package (available at http://www.cgc.com) using either a Blossom 63 matrix or a PAM250 matrix, and a gap weight of 12, 10, 8, 6, or 4 and a length weight of 2, 3, or 4. In yet another embodiment, the percent identity between two nucleic acid sequences can be accomplished using the GAP program in the CGC software package (available at http://www.cgc.com), using a gap weight of 50 and a length weight of 3. Thus, a substantially homologous amino acid or nucleotide sequence means an amino acid or nucleotide sequence that is largely but not wholly homologous to a nucleic acid molecule described herein, and which retains the same functional activity as the molecule to which it is homologous.

Also described herein are variant reproduction-specific nucleic acid molecules which are characteristic/indicative of infertility in men; mRNAs from

which the cDNA is transcribed (mRNAs that encode the cDNA); proteins encoded by each of the nucleic acid molecules presented herein and by variations thereof (nucleic acid molecules that, due to the degeneracy of the genetic code, encode an amino acid sequence presented herein or a functional equivalent thereof); variant proteins associated with or indicative of lack of or reduction in sperm count (variant reproduction-specific proteins); characteristic portions of each of the proteins described herein; and antibodies that bind reproduction-specific proteins or variant reproduction-specific proteins or characteristic portions of these proteins.

The SEQ ID NO. for each of the sequences presented herein is shown in Table 1. Where shown, lower case letters in the figures indicate untranslated regions of the DNA. However, not all untranslated regions are shown in lower case letters. The skilled artisan can determine the appropriate coding region for each cDNA described herein using methods (e.g., computer programs) that are routine in the art.

Table 1 List of Sequence ID Numbers for cDNA, Protein and Genomic Sequences

SEQ ID NO.	Gene Name	Gene Symbol	Sequence	GenBank- NO.
1	Spg1	Taf2q	cDNA	AF285574
2	Spg1	Taf2q	Protein	AF285574
3	Spg2	Tex11	cDNA	AF285572
4	Spg2	Tex11	Protein	AF285572
5	Spg3	Nxf2	cDNA	AF285575
6	Spg3	Nxf2	Protein	AF285575
7	Spg5	Tex15	cDNA	AF285589
8	Spg5	Tex15	Protein	AF285589
9	Spg13	Rnf17	cDNA	AF285585
10	Spg13	Rnf17	Protein	AF285585
11	Spg14	Scmh2	cDNA	AF285577
12	Spg14	Scmh2	Protein	AF285577
13	Spg15	Mov10l1	cDNA	AF285587
14	Spg15	Mov10l1	Protein	AF285587
15	Spg16	Piwil2	cDNA	AF285586
16	Spg16	Piwil2	Protein	AF285586
17	Spg17	Tktl1	cDNA	AF285571
18	Spg17	Tktl1	Protein	AF285571
19	Spg18	Tex12	cDNA	AF285582
20	Spg18	Tex12	Protein	AF285582
21	Spg25	Usp26	cDNA	AF285570
22	Spg25	Usp26	Protein	AF285570
23	Spg27		cDNA	
24	SPg27		Protein	
25	Spg33	Tex19	cDNA	AF285590
26	Spg33	Tex19	Protein	AF285590
27	Spg34	Fthl17	cDNA	AF285569
28	Spg34	Fthl17	Protein	AF285569
29	SPg39	Tex13	cDNA	AF285576
30	Spg39	Tex13	Protein	AF285576
31	Spg46	Stk31	cDNA	AF285580
32	Spg46	Stk31	Protein	AF285580
33	Spg58	Tex16	cDNA	AF285573
34	Spg58	Tex16	Protein	AF285573
35	Spg59	Tex20	cDNA	AF285588
36	Spg59	Tex20	Protein	AF285588
37	Spg64		cDNA	
38	Spg64		Protein	
39	Spg65	Rnh2	cDNA	AF285581
40	Spg65	Rnh2	Protein	AF285581
41	Spg69	Pramel1	cDNA	AF285578
42	Spg69	Pramel1	Protein	AF285578
43	Spg70	Tdrd1	cDNA	AF285591
44	Spg70	Tdrd1	Protein	AF285591

45	Spg85	Tex14	cDNA	AF285584
46	Spg85	Tex14	Protein	AF285584
47	Spg87	Tex18	cDNA	AF285583
48	Spg87	Tex18	Protein	AF285583
49	Spg84	Tex17	cDNA	AF285579
50	hSPG1	TAF2Q	cDNA	AF285595
51	hSPG1	TAF2Q	Protein	AF285595
52	hSPG3a	NXF2	cDNA	AF285596
53	hSPG3a	NXF2	Protein	AF285596
54	hSPG3a		Genomic	
55	hSPG3b		cDNA	
56	hSPG5	TEX15	cDNA	AF285605
57	hSPG5	TEX15	Protein	AF285605
58	hSPG5		Genomic	
59	hSPG15	MOV10L1	cDNA	AF285604
60	hSPG15	MOV10L1	Protein	AF285604
61	hSPG15		Genomic	
62	hSPG18	TEX12	cDNA	AF285600
63	hSPG18	TEX12	Protein	AF285600
64	hSPG25	USP26	cDNA	AF285593
65	hSPG25	USP26	Protein	AF285593
66	hSPG27		cDNA	
67	hSPG34a		cDNA	
68	hSPG34a		Protein	
69	hSPG34b	FTHL17	cDNA	AF285592
70	hSPG34b	FTHL17	Protein	AF285592
71	hSPG39a	TEX13A	cDNA	AF285597
72	hSPG39a	TEX13A	Protein	AF285597
73	hSPG39a		Genomic	
74	hSPG39b	TEX13B	cDNA	AF285598
75	hSPG46	STK31	cDNA	AF285599
76	hSPG46	STK31	Protein	AF285599
77	hSPG64		cDNA	
78	hSPG64		Protein	
79	hSPG85	TEX14	cDNA	AF285601
80	hSPG85	TEX14	Protein	AF285601
81	hSPG13 long	RNF17	cDNA	AF285602
82	hSPG13 long	RNF17	Protein	AF285602
83	hSPG13 short	RNF17	cDNA	AF285603
84	hSPG13 short	RNF17	Protein	AF285603
85	hSPG39b	TEX13B	Protein	AF285598
86	hSPG39b		Genomic	

87	hSPG70	TDRD1	cDNA	AF285606
88	hSPG70	TDRD1	Protein	AF285606
89	hSPG2	TEX11	cDNA	AF285594
90	hSPG2	TEX11	Protein	AF285594

As used herein, the terms "reproduction-specific nucleic acid molecules" and "reproduction-specific genes" refer, respectively, to reproduction-specific nucleic acid molecules and reproduction-specific genes which are male germ cell-specific, testis-specific or testis- and ovary-specific. As used herein, the terms "variant reproduction-specific nucleic acid molecules" and "variant reproduction-specific genes" refer, respectively, to reproduction-specific nucleic acid molecules and reproduction-specific genes which are male germ cell-specific, testis-specific or testis- and ovary-specific. Variant reproduction-specific nucleic acid molecules or genes can differ from reproduction-specific nucleic acid molecules in nucleic acid sequence (e.g., deletion of one or more nucleotides, addition of one or more nucleotides or substitution or change in one or more nucleotides) or by their "loss" either physically or by failure of/or reduction in expression.

As used herein, the term "isolated" refers to substances which are obtained from (separated from) the sources in which they occur in nature, as well as to substances (e.g., nucleic acid molecules, proteins, peptides) produced by recombinant/genetic engineering methods or by synthetic (chemical) methods.

Also the subject of the present invention are methods in which the nucleic acid molecules, proteins, and antibodies of the present invention are useful. Such methods include a method of identifying genes or proteins characteristic of male infertility, which include variant genes or proteins present in infertile men, but not in fertile men, and nucleic acid molecules or proteins present at different levels or at a different stage(s) in differentiation in infertile men than in fertile men. Also included is a method of diagnosing or aiding in the diagnosis of infertility in men, and a method of contraception in which sperm production or sperm count is reduced (no sperm is produced, sperm is produced to a lesser extent than normal in an individual) or defective sperm is produced (e.g., sperm with reduced motility, lifespan or testicular maturation arrest, or sertoic cell defects). As used herein, the

terms "infertility in men" or "male infertility" include spermatogenic failure, a lack of sperm production, a severely reduced sperm count and production of defective sperm, each of which results in the inability or a severely reduced ability to cause fertilization.

Tex11 is a reproduction-specific gene that is X chromosome-linked. Its 3kb cDNA encodes a 917-residue protein that has no homology with other known proteins. The Tex11 gene is approximatly 400kb and consists of 29 exons. As described in Example 2, 380 infertile males and 93 fertile males (fathers) were studied and 33 mutations were found in the nucleic acid sequence of TEX11; of these, 21 were found only in infertile males. These mutations include A320G, T325A, C381T, G400A, A491G, G1282A, C1449A, T2219C, A2250T, T2295C and T2472C and also shown is a two base pair insertion in exon 15 at nucleotide position 1233 (denoted as ins(2bp)) in Figure 108. A clustering of mutations is found in the 3' but not the 5' regions of the intron. These nucleic acid alterations are shown in Figure 108.

Another X linked reproduction-specific gene identified as containing variants as described herein is TAF2Q. The TAF2Q DNA and amino acid variations associated with infertility are shown in Figure 112.

Isolated nucleic acid molecules (nucleic acid molecule genes, cDNAs, mRNA, RNA) of the present invention are of mammalian origin, such as of mouse (designated as Spg) , human (designated as hSpg) or other primate, canine, feline or bovine origin.

Both reproduction-specific nucleic acid molecules and variant reproduction-specific nucleic acid molecules are useful as hybridization probes or primers for an amplification method, such as polymerase chain reaction, to show the presence, absence or alteration of a gene(s) described herein. Probes and primers can comprise all or a portion of the nucleotide sequence (nucleic acid sequence) of a reproduction-specific nucleic acid molecule described herein or all or a portion of its complement. They can also comprise all or a portion of a variant reproduction-specific nucleic acid molecule which portion is characteristic of (indicative of) infertility or all or a portion of its complement. The probes and primers can be of

any length, provided that they are of sufficient length and appropriate composition (appropriate nucleotide sequence) to hybridize to all or an identifying or characteristic portion of a gene indicative of infertility in men and remain hybridized under the conditions used. Useful probes include nucleic acid molecules which distinguish between a reproduction-specific nucleic acid molecule described herein and a variant form of such a nucleic acid molecule that is indicative of infertility in men. Generally, the probe will be at least 14 nucleotides; the upper limit is the length of the nucleic acid molecule itself. Probes can be, for example, 14 to 20 nucleotides or longer (e.g., 15 to 25, 20 to 40, 30 to 50 or any other length appropriate to specifically hybridize to a reproduction-specific gene or a variant reproduction-specific nucleic acid molecule and remain hybridized to nucleic acid molecules in a sample under the conditions used). The length of a specific probe will also be determined by the method in which it is used.

The genes described herein are useful to detect variant reproduction-specific nucleic acid molecules present in a nucleic acid molecule sample obtained from men with lack of or reduction in sperm production, but not present in a nucleic acid molecule sample obtained from fertile men. Variant reproduction-specific nucleic acid molecules (e.g., having large alterations or deletions and small alterations or deletions such as short deletions, point mutations and small insertions) can be identified with reference to reproduction-specific nucleic acid molecules/gene sequences presented herein. For example, nucleic acid molecules from infertile men with normal karyotypes and no Y chromosome microdeletions can be assessed. All human spermatogonic genes can be screened in a group of infertile men (with no or low sperm counts) using PCR. One pair of PCR primers can be designed for each spermatogonic gene to produce a 200 bp PCR product or a PCR product of any appropriate length. A negative PCR result indicates the absence of a particular gene in an individual and can be confirmed by Southern blot. Small variations can be searched for in X-linked genes by nucleic acid molecule sequencing. Fertile men are used as controls. If a variant reproduction-specific gene is identified, additional infertile men can be similarly screened to further confirm that the variant reproduction-specific nucleic acid molecule is associated with/indicative of

infertility in men. Alterations which are specific to infertile men can be used in the diagnosis of male infertility, alone or in conjunction with other methods of assessing male infertility.

The spermatogonic genes are strong candidates for pure male sterility factors. A mutation in such a gene could alter its function in spermatogenesis and therefore cause male infertility. These novel genes are promising for the following reasons: first, they are germ cell-specific and expressed in spermatogonia. Two known germ cell-specific Y-linked human genes, RBM and DAZ, are also expressed in spermatogonia and are strongly implicated in male infertility when deleted. The mouse homologues of RBM and DAZ were also identified in the subtraction protocol described in the Examples, suggesting an important role for other spermatogonic genes in male fertility. Second, nearly 50% of novel germ cell-specific genes are located on Chromosome X. This is significant from a theoretical point of view, indicating that Chromosome X may play the most important role in male fertility. From a practical point of view, this result shows that mutations in infertile men are more likely to be found in X-linked genes than in autosomal genes. It is also far easier to search the X chromosome than within autosomes. In males, there is only one copy of the X-linked gene. For example, to find a mutation with a frequency of 1% in the population, one can screen 100 individuals if it is X-linked. If the gene is autosomal, one has to screen 10,000 individuals (1% x 1% = 0.01%) to find a homozygous mutation. However, the method described herein applies to the search for variations in infertile men in both X-linked and autosomal genes of this invention.

In a further embodiment, the present invention is a method of diagnosing reduced (partially or totally) sperm count or infertility in a man. For example, a method of diagnosing infertility in a man comprises (a) comparing the nucleic acid sequence of reproduction-specific nucleic acid molecules obtained from a man in whom infertility is to be assessed with the nucleic acid sequence of a corresponding variant reproduction-specific nucleic acid molecules from infertile men, wherein the corresponding variant reproduction-specific nucleic acid molecules comprises an alteration characteristic of infertility in men; and (b) determining whether the

alteration characteristic of infertility in men is present in the reproduction-specific nucleic acid molecules obtained from the man in whom fertility is to be assessed. If the alteration is present in the nucleic acid molecules obtained, infertility is diagnosed in the man. A corresponding variant reproduction-specific nucleic acid molecule is a reproduction-specific nucleic acid molecule of the same chromosomal location as the chromosomal location of nucleic acid molecule being analyzed (a nucleic acid molecule obtained from a man being assessed). One or more of the nucleic acid molecules described herein, or a portion(s) of one or more of the nucleic acid molecules or nucleic acid molecules that hybridize to nucleic acid molecules described herein or to a complement thereof can be used in a diagnostic method, such as a method to determine whether a gene(s) or a portion of a gene(s) described herein is missing or altered in men. Any man may be assessed with this method of diagnosis. In general, the man will have been at least preliminarily assessed, by another method, as having reduced sperm count. By combining nucleic acid probes derived from a sequence presented herein that is present in the DNA of fertile men, but not in the DNA of infertile men, with the nucleic acid molecules from a sample to be assessed, under conditions suitable for hybridization of the probes with DNA present in fertile men, but not with variant DNA, it can be determined whether the sample from a man to be assessed comprises thevariant reproduction-specific nucleic acid molecules. If the nucleic acid molecule is unaltered (is not a variant reproduction-specific nucleic acid molecules), it may be concluded that the alteration of the gene is not responsible for the reduced sperm count. Alternatively, the hybridization conditions used can be such that the probes will hybridize only with variant reproduction-specific nucleic acid molecules and not with reproduction-specific nucleic acid molecules.

Nucleic acid molecules assessed by the present method can be obtained from a variety of tissues and body fluids, such as blood or semen. In one embodiment, the above methods are carried out on nucleic acid molecules obtained from a blood sample. For example, a nucleic acid sample from men who are infertile or have a low sperm count is assessed to determine whether all or a portion of a nucleic acid molecule(s) described herein differs in sequence from the sequence of a

corresponding nucleic acid molecule obtained from fertile men. In one embodiment, the altered nucleic acid molecules or gene which is assessed is one which differs from a sequence described herein by a deletion, addition or substitution of at least one nucleotide. In a second embodiment, the altered nucleic acid molecule or gene is "missing" in that it is physically absent or not expressed/under-expressed (functionally absent). If an alteration occurs in a nucleic acid molecule obtained from infertile men, but not fertile men, it is indicative of (characteristic of) infertility and, thus, useful in the diagnosis of infertility in men. Such a nucleic acid molecule or gene is referred to as variant reproduction-specific nucleic acid molecule or variant reproduction-specific gene.

This invention also relates to proteins encoded by the genes or portions of the genes described herein, proteins encoded by variant nucleic acid molecules (or portions thereof) that are characteristic of infertility in men), or by portions thereof and antibodies that recognize (bind) proteins described herein. Such antibodies are useful in a diagnostic method to determine whether an intact or variant protein(s) is present in a sample (e.g., semen or testis biopsy) obtained from a man being assessed for infertility. They are also useful for identifying the expression of the gene(s) in a particular cell type or at a particular developmental stage. These antibodies can be used for studies of spermatogenesis. These antibodies can be used for immunofluorescence of germ cells, or in Western blots for assessing the presence of the protein the antibody binds.

The invention also provides expression vectors containing a reproduction-specific nucleic acid molecule of the present invention which is operably linked to at least one regulatory sequence. "Operably linked" is intended to mean that the nucleotide sequence is linked to a regulatory sequence in a manner which allows expression of the nucleotide sequence. The term "regulatory sequence" includes promoters, enhancers, and other expression control elements (see, e.g., Goeddel, Gene Expression Technology: Methods in Enzymology 185, Academic Press, San Diego, CA (1990)). It should be understood that the design of the expression vector may depend on such factors as the choice of the host cell to be transformed and/or the protein or peptide desired to be expressed. For instance, the proteins and

peptides of the present invention can be produced by ligating the cloned gene, or a portion thereof, into a vector suitable for expression in either prokaryotic cells, eukaryotic cells or both (see, for example, Broach, *et al.*, Experimental Manipulation of Gene Expression, ed. M. Inouye (Academic Press, 1993) p. 83; Molecular Cloning: A Laboratory Manual, 2nd Ed., Sambrook *et al.* (Cold Spring Harbor Laboratory Press, (1989) Chapters 16 and 17).

Prokaryotic and eukaryotic host cells transfected by the described vectors are also provided by this invention. For instance, cells which can be transfected with the vectors of the present invention include, but are not limited to, bacterial cells, such as *E. coli*, insect cells (baculovirus), yeast and mammalian cells, such as Chinese hamster ovary (CHO) cells.

Thus, a nucleotide sequence described herein can be used to produce a recombinant form of the encoded protein via microbial or eukaryotic cellular processes. Production of a recombinant form of the protein can be carried out using known techniques, such as by ligating the oligonucleotide sequence into a DNA or RNA construct, such as an expression vector, and transforming or transfecting the construct into host cells, either eukaryotic (yeast, avian, insect or mammalian) or prokaryotic (bacterial cells). Similar procedures, or modifications thereof, can be employed to prepare recombinant proteins according to the present invention by microbial means or tissue-culture technology.

The present invention also pertains to pharmaceutical compositions comprising the proteins and peptides described herein. For instance, the peptides or proteins of the present invention can be formulated with a physiologically acceptable medium to prepare a pharmaceutical composition. The particular physiological medium may include, but is not limited to, water, buffered saline, ployols (e.g., glycerol, propylene glycol, liquid polyethylene glycol) and dextrose solutions. The optimum concentration of the active ingredient(s) in the chosen medium can be determined empirically, according to procedures well known in the art, and will depend on the ultimate pharmaceutical formulation desired. Methods of introduction of exogenous polypeptides at the site of treatment include, but are not limited to, intradermal, intramuscular, intraperitoneal, intravenous, subcutaneous,

oral and intranasal methods. Other suitable methods of introduction can also include rechargeable or biodegradable devices and slow release polymeric devices. The pharmaceutical compositions of this invention can also be administered as part of a combinatorial therapy with other agents.

This invention also has utility in methods of treating disorders of reduced sperm count or enhancing/increasing sperm count and/or sperm activity. Reduced sperm count can be increased, for example, by administering a drug or agent that enhances the activity of a reproduction-specific gene or genes, with the result that sperm count is enhanced. Alternatively it can be used in a method of gene therapy, whereby the gene or a gene portion encoding a functional protein is inserted into cells in which the functional protein is expressed and from which it is generally secreted to remedy the deficiency caused by the defect in the native gene.

The invention described herein also has application to the area of male contraceptives. Variant reproduction-specific genes indicative of infertility can be used to design agents which mimic the activity of the altered gene product(s). Thus, the present invention also relates to agents or drugs, such as, but not limited to, peptides or small organic molecules which mimic the activity (effects) of the variant gene product(s) of reproduction-specific genes (a variant reproduction-specific protein) of the present invention shown to be present in infertile men, but not in fertile men. One embodiment of this invention is a method of contraception (a method of reducing sperm production and/or sperm activity) in a man, comprising administering to the man an agent that mimics the effects of a variant reproduction-specific protein in the man, whereby sperm production, sperm activity or both are reduced (and preferably abolished) in the man.

Alternatively, the agent or drug is one which blocks or inhibits the expression, activity or function of the reproduction-specific gene (e.g., an oligonucleotide or a peptide which blocks or inhibits the expression, activity or function of a reproduction-specific gene present in nucleic acid molecules of fertile men). The ideal agent will enter the cell, in which it will block or inhibit the function of the gene, directly or indirectly. Alternatively, an agent or drug can

inhibit the activity or function of one or more proteins encoded by reproduction-specific nucleic acid molecules.

Reproduction-specific nucleic acid molecules described herein, such as those that encode proteins which have enzymatic activity, are potential targets of such blocking agents or inhibitors, as are the encoded proteins. For example, Spg17, which encodes a transketolase, and its human homologue; Spg25, which encodes a deubiquitinating enzyme, and its human homologue enzyme; Spg65, which encodes a RNase inhibitor, and its human homologue; and Spg85, which encodes a tyrosine protein kinase, and its human homologue can be targets of inhibitors, as can the encoded proteins. Agents that inhibit the gene, directly or indirectly, and/or the encoded product, directly or indirectly, are potential contraceptive agents. Agents that inhibit the gene, directly or indirectly, and/or the encoded product, directly or indirectly, are potential contraceptive agents.

Identification of a blocking agent or inhibitor of a reproduction-specific gene or an encoded product can be carried out using known methods. For example, a gene for which an inhibitor is to be identified can be expressed in an appropriate host cell (e.g., mouse or human cell lines), in the presence of an agent or drug to be assessed for its ability to block or inhibit a reproduction-specific gene(s) (a candidate drug). The ability of the candidate drug to do so can be assessed in several ways. For example, its effect on expression of the gene (e.g., by determining if the gene product is present in the host cells, by immunoassay or Western blot) can be assessed. Alternatively, binding of the candidate drug to the reproduction-specific gene or to the encoded protein can be assessed, as can degradation or disruption of the gene or the encoded protein. For example, hSPG25 has two catalytic domains (Cys domain and His domain) that are conserved within the ubiquitin specific protease family (Usp) members. In a bacterial assay (Baker et al., J Biol Chem 267, 23364-75 (1992)), the enzyme encoded by hSPG25 might cleave the Ub (ubiquitin) moiety from the substrate Ub-Arg-β-Gal, a fusion protein of Ub and *E. coli* β galactosidase linked by an arginine. *E. coli* expressing Ub-Arg-β-gal only will form blue colonies in the presence of its chromogenic substrate X-Gal. A deubiquitinating enzyme, like hSPG25, introduced in *E. coli* would cleave Ub-Arg-

β-Gal into Ub and Arg-β-Gal, which is an unstable protein, thus forming white colonies. A candidate drug would block the deubiquitinating activity of hSPG25. *E. coli* expressing both Ub-Arg-β-Gal and hSPG25 should form blue colonies in the presence of X-Gal and the candidate drug.

The present invention also relates to antibodies that bind a protein or peptide encoded by all or a portion of the reproduction-specific nucleic acid molecule, as well as antibodies which bind the protein or peptide encoded by all or a portion of a variant nucleic acid molecule. For instance, polyclonal and monoclonal antibodies which bind to the described polypeptide or protein are within the scope of the invention. In a specific embodiment, this invention relates to antibodies (polyclonal or monoclonal) that bind a protein or peptide that is associated with or indicative of infertility in men (a variant protein or peptide). Such antibodies can be used, alone or in combination with antibodies that bind proteins or peptides encoded by reproduction-specific nucleic acid molecules found in fertile men, in immunoassays carried out to diagnose or aid in the diagnosis of infertility.

Antibodies of this invention can be produced using known methods. An animal, such as a mouse, goat, chicken or rabbit, can be immunized with an immunogenic form of the protein or peptide (an antigenic fragment of the protein or peptide which is capable of eliciting an antibody response). Techniques for conferring immunogenicity on a protein or peptide include conjugation to carriers or other techniques well known in the art. The protein or peptide can be administered in the presence of an adjuvant. The progress of immunization can be monitored by detection of antibody titers in plasma or serum. Standard ELISA or other immunoassays can be used with immunogen as antigen to assess the levels of antibody. Following immunization, anti-peptide antisera can be obtained, and if desired, polyclonal antibodies can be isolated from the serum. Monoclonal antibodies can also be produced by standard techniques which are well known in the art (Kohler and Milstein, *Nature* 256:4595-497 (1975); Kozbar *et al., Immunology Today* 4:72 (1983); and Cole *et al., Monoclonal Antibodies and Cancer Therapy,* Alan R. Liss, Inc., pp. 77-96 (1985)). Such antibodies are useful as diagnostics for

the intact or disrupted gene, and also as research tools for identifying either the intact or disrupted gene.

As described in Example 2, chromosomal mapping of the genes described herein demonstrated the surprisingly large number of genes on sex chromosome X. This is the strongest evidence to date in support of the population genetics theory first suggested by R. A. Fisher and formalized by W. Rice. (Fisher, R.A., Biol. Rev. 6, 345-368 (1931); Rice, W., Evolution 38, 735-742 (1996); Hurst, L.D. and J.P. Randerson, Trends Genet. 15, 383-385 (1999)). This theory argues that sexually antagonistic traits (beneficial in one sex, but detrimental or neutral in the other) on chromosome X tend to be strongly selected and, therefore, accumulate. Male germ cell-specific genes are only expressed in males and are, therefore, sexually antagonistic genes. The work described herein has resulted in identification of a number of testis-specific genes on chromosome X in both mice and humans.

In 1922, JBS Haldane observed that when in the offspring of two different animal races one sex is absent, rare, or sterile, that sex is the heterozygous sex (XY or ZW) (Haldane JBS., *J. Genet.* 12:101-109 (1922)). Thus, in humans, males (XY) are sterile and female (XX) are fertile. This rule is obeyed in all animals: lepidoptera, birds, flies and mammals. The significance of this is the early stage in speciation, known as the origin of species. Haldane's rule incorporates the following in his hypotheses: incompatibility between X- and Y linked genes, meiotic drive, disruption of dosage compensation, X-autosome translocation, dominance theory, faster-male theory and faster -X theory. The two assumptions made are that there are an abundance of "speciation genes" on X chromosome and the rapid evolution of "speciation genes". The result of the male sterility is reproduction isolation and the origin of two species.

Hybrid male sterility in mice has been mapped to *Hst-1* and *Hst-3* locus (Forejt J. *et al., Mammalian Genome* 1:84-91(1991); Matsuda Y. *et al.*, Proc. Natl. Acad. Sci. USA 88:4850-4954 (1991)). In one study, the species *M.m. musculus* crossed with *M.m. domesticus*, the male sterility mapped to chromosome 17 t-complex (Hst-1 locus) and resulted in meiotic arrest of the spermatagonia. The X-Y dissociation and autosomal dissociation are high and the nature of the defect is genetic. In the other

study, *M. spretus* crossed with *M.m.domesticus* resulting in male sterility mapped to chromosome X distal end producing meiotic arrest of the spermatagonia, The X-Y dissociation is high/low, the autosomal dissociation high/low and the mature of the defect may be structural.

The present invention is illustrated by the following Examples, which are not intended to be limiting in any way. The teaching of all references cited herein are incorporated by reference in their entirety.

EXAMPLES

Example 1. Isolation and Cloning of Reproduction-Specific Genes from Mice

Isolation of Mouse Spermatogonia.

Spermatogonia were isolated by the Staput method of sedimentation velocity at unit gravity (Bellve, A.R.. *Methods Enzymol.* 225, 84-113 (1993)). Primitive type A spermatogonia were prepared from testes of 6-day-old CD-1 mice (Charles River Laboratories). Mature type A and type B spermatogonia were isolated from 8-day-old CD-1 mice. By microscopic examination, at least 85% of the cells in the resulting preparations were spermatogonia, with no more than 15% somatic cell contamination.

cDNA Subtraction.

Three independent subtraction experiments were carried out using cDNAs from primitive type A, type A, or type B spermatogonia as the tracer. In all cases, tracer and driver cDNAs were derived from oligo(dT)-selected RNAs. Germ-cell-depleted testes were from w^v/w^v animals. Prior to subtraction, tracer and driver cDNAs were digested to completion with *Rsa* I. In each of the three experiments, we carried out one round of subtraction was performed using the "PCR-select" protocol (Clontech)(Diatchenko, L. *et al. Proc. Natl. Acad. Sci. USA* 93, 6025-6030 (1996). To more thoroughly subtract ubiquitous cDNAs, four additional rounds of subtraction were performed using a modified procedure (Douglas Menke, Whitehead Institute, personal communication) as described in Lavery, D.J.,*et al.*; *Proc. Natl.*

Acad. Sci. USA 94, 6831-6836 (1997). Between rounds of subtraction, enrichment of *Dazl* cDNA (germ-cell-specific) was monitored and disappearance of *G3PDH* cDNA (ubiquitous) was monitored. Three plasmid libraries (one for each of the three independent experiments) were prepared from the resulting pools of subtracted cDNA fragments. 800 randomly selected clones from each of the three libraries (one read only) were sequenced. Of the 2400 sequences generated, 165 were of poor quality or derived from the cloning vector, leaving 2235 sequences for further analysis.

Sequence Analysis.

Of the 2235 sequence fragments, 409 corresponded to 13 previously reported germ-cell-specific genes (142 to *Mage*, 11 to *Ube1y*, 2 to *Usp9y*, 44 to *Rbmy*, 10 to *Tuba3/Tuba7*, 2 to *Stra8*, 45 to *Ott*, 16 to *Sycp2*, 3 to *Sycp1*, 3 to *Figla*, 8 to *Sycp3*, 21 to *Ddx4*, and 102 to *Dazl*). Among the remaining 1826 sequence fragments, each was searched electronically for redundancies and identities to known genes. 98 unique, novel sequence fragments were found that were each recovered at least twice. Each of these 98 sequences was tested for germ cell specificity by RT-PCR on 14 tissues. Of the 98 sequences, 45 were found to be expressed in spermatogonia and wild-type testis, but not in somatic tissues including w^v/w^v testis, indicating that they are germ cell specific. After full-length cDNA sequences were assembled, these 45 sequence fragments were found to derive from a total of 23 different genes. Of the original set of 2235 sequence fragments, 546 corresponded to these 23 novel genes (8 to *Fthl17*; 29 to *Usp26*; 38 to *Tktl1*; 66 to *Tex11*; 2 to *Tex16*; 132 to *Taf2q*; 57 to *Pramel3*; 13 to *Nxf2*; 5 to *Tex13*; 4 to *Pramel1*; 3 to *Tex17*; 2 to *Stk31*; 6 to *Rnh2*; 29 to *Tex12*; 4 to *Tex18*; 2 to *Tex14*; 8 to *Rnf17*; 16 to *Piwil2*; 36 to *Mov10l1*; 7 to *Tex20*; 71 to *Tex15*; 6 to *Tex19*; 2 to *Tdrd1*).

cDNA Cloning.

Full-length mouse cDNA sequences were composites derived from subtracted cDNA clones, 5' and 3' RACE products, and clones isolated from conventional cDNA libraries that were prepared from adult testes (Clontech, Palo

Alto, CA; Stratagene, La Jolla, CA; and one library of our own construction). Orthologous human sequences were identified by searching GenBank using mouse cDNA sequences. Full-length human cDNA sequences were obtained by screening a cDNA library prepared from adult testes (Clontech).

RH Mapping.

Using PCR, genomic DNAs from the 93 cell lines of the mouse T31 radiation hybrid panel (Research Genetics, Huntsville, AL) were tested for the presence of each gene (McCarthy, L.C. *et al.*, Genome Res. 7, 1153-1161 (1997). PCR conditions and primer sequences have been deposited at GenBank, where accession numbers are as follows: *Figla*, G65193; *Magea5*, G65194; *Ddx4*, G65195; *Ott*, G65196; *Sycp2*, G65197; *Sycp3*,G65198; *Stra8*,G65199; *Tuba3*, G65200; *Tuba7*, G65201; *Fthl17*, G65202; *Mov10l1*,G65203; *Nxf2*,G65204; *Piwil2*, G65205; *Pramel1*, G65206; *Pramel3*, G65331; *RNF17*, G65207; *Rnh2*, G65208; *Stk31*, G65210; *Taf2q*, G65211; *Tdrd1*, G65212; *Tex11*, G65213; *Tex12*, G65214; *Tex13*, G65215; *Tex14*, G65216; *Tex15*, G65217; *Tex16*, G65218; *Tex17*, G65219; *Tex18*, G65220; *Tex19*, G65221; *Tex20*, G65222; *Tktl1*, G65223; and *Usp26*, G65224. Analysis of the results positioned the genes with respect to the radiation hybrid map of the mouse genome constructed at the Whitehead/MIT Center for Genome Research (Van Etten, W.J. *et al.*,. Nature Genet. 22, 384-387 (1999) (www-genome.wi.mit.edu/mouse_rh/index.html). Chromosomal mapping data of human genes were retrieved from GenBank and confirmed by RH mapping using the GeneBridge 4 panel (Research Genetics).

Expression Analysis.

RT-PCR conditions and primer sequences have been deposited at GenBank, where accession numbers for mouse genes are as follows: *Gapd*, G65758; *Fshr*, G65759; *Dazl*, G65760; *Rbmy*, G65761; *Fthl17*, G65778; *Mov10l1*, G65779; *Nxf2*, G65780; *Piwil2*, G65781; *Pramel1*, G65762; *Pramel3*, G65782; *Rnf17*, G65763; *Rnh2*, G65783; *Stk31*, G65784; *Taf2q*, G65785; *Tdrd1*, G65786; *Tex11*, G65787; *Tex12*, G65788; *Tex13*, G65789; *Tex14*, G65790; *Tex15*, G65791; *Tex16*, G65792;

Tex17, G65793; *Tex18*, G65794; *Tex19*, G65795; *Tex20*, G65796; *Tktl1*, G65797; *Usp26*, G65798. Accession numbers for human genes are as follows: *FTH1*, G65764; *FTHL17*, G65765; *MOV10L1*, G65766; *NXF2*, G65767; *RNF17*, G65799; *STK31*, G65768; *TAF2Q*, G65769; *TDRD1*, G65770; *TEX11*, G65771; *TEX12*, G65772; *TEX13A*, G65773; *TEX13B*, G65774; *TEX14*, G65775; *TEX15*, G65776; *USP26*, G65777.

Example 2. Isolation and Cloning of Reproduction-Specific Genes

380 infertile men (217 azoospermia and 163 oligospermia) and 93 fertile males were screened for mutations in two X-linked genes (TAF2Q and TEX 11). The Klondike PCR-based subtraction protocol (Diatchenko, L. *et al.*, Methods Enzymol. 303, 349-80 (1999); Diatchenko, L. *et al.*, Proc. Natl. Acad. Sci. USA 93, 6025-30 (1996) and a modified subtraction protocol (modified by Doug Menke, personal communication) (Lavery, D.J. *et al.*, Proc. Natl. Acad. Sci. USA 94, 6831-6 (1997), Yang M. *et al.*, Anal. Biochem. 237(1):109-14 (1996); Ausubel, F.M. *et al.*, Current Protocols in Molecular Biology (1997)) were used to generate a subtraction cDNA library for each type of spermatogonia. In detail, cDNAs synthesized from mRNAs of infertile males and fertile males' spermatogonia were subtracted against a mixture of cDNAs found in great excess derived from mRNAs of 11 different somatic tissues (heart, brain, lung, liver, skeletal muscle, kidney, spleen, stomach, thymus, skin and w^v/w^v testis). w^v/w^v testes are essentially devoid of germ cells (Geissler, E.N. *et al.*, *Cell* 55, 185-192 (1988)). After subtraction, germ cell-specific genes are expected to be enriched and ubiquitous genes to be removed to a certain degree. The subtractions were successful, as demonstrated by the enrichment of Dazl transcript (germ cell-specific) (Reijo, R., *et al.*, Genomics 35, 346-52 (1996)) and the disappearance of G3PDH transcript (ubiquitous, present in all the tissues). The subtracted cDNAs were directly cloned into a plasmid vector to make a subtracted cDNA library. A library was constructed from infertile men and fertile men. Clones randomly picked from each library were sequenced, using ABI 370 sequencer (ABI, Foster City, CA). A total of 2300 sequences was obtained. A combination of different methods was used to obtain full-length cDNA sequences:

subtracted DNA sequencing, cDNA library screening of Stratagene and Clontech testis cDNA libraries (Stratagene, La Jolla, CA and Clontech, Palo Alto, CA), direct RT PCR of testis cDNAs and sequencing, 5' RACE (rapid amplification of cDNA ends) (Ausubel, F.M. *et al.,* Current Protocols in Molecular Biology (1997)), 3' RACE, and direct screening and amplification of cDNA library subpools by PCR using one gene-specific primer and one vector-specific primer.

To determine the germ cell specificity, RT-PCR assay (reverse transcription polymerase chain reaction) of each clone was performed on a panel of thirteen different tissues (heart, brain, lung, liver, skeletal muscle, kidney, spleen, stomach, thymus, skin and w^v/w^v testis) (Ausubel, F.M. et al, Current Protocols in Molecular Biology (1997)). These novel X linked genes are designated FTH1, FTHL17, USP26, TEX 11, TAF2Q, NXF2, TEX13A, TEX13B, STK31, TEX12, TEX14, RNF17, MOV10L1, TEX15 and TDRD1.

The mutations in TEX 11 and TAF2Q were analyzed further. The structure of the gene was assessed, TEX11 BAC's and sequence was screened, primers were chosen spanning each exon. Infertile men were screened and the two genes sequenced. Polymorphism and causality were distinguished by looking at normal male controls, nature of variants, study of maternal relative (linkage), conservation between mouse and human, and splicing in vivo. There were 33 mutations found in TEX11, 12 in exons (4 silent) and 21 in intron. 21 were found only in infertile males (380 males), 1 found only in normal (fertile) males (93 males) and 11 polymorphisms (found in both infertile and normal males). The variants of TEX 11 are depicted in Figure 108.

There were 15 variants found in TAF2Q, 7 in exons and 8 in introns. Of these, 5 were polymorphisms(found in both infertile and normal males), 9 were found only in infertile males, and 1 was found only in normal fertile males. Figure 112 depicts the variants in TAF2Q.

A combination of different methods was used to obtain full-length cDNA sequences: subtracted DNA sequencing, cDNA library screening of Stratagene and Clontech testis cDNA libraries (Stratagene, La Jolla, CA and Clontech, Palo Alto, CA), direct RT PCR of testis cDNAs and sequencing, 5' RACE (rapid amplification

of cDNA ends) (Ausubel, F.M. *et al.*, Current Protocols in Molecular Biology (1997)), 3' RACE, and direct screening and amplification of cDNA library subpools by PCR using one gene-specific primer and one vector-specific primer.

CLAIMS

What is claimed is:

1. An isolated reproduction-specific nucleic acid molecule comprising a nucleic acid molecule having a nucleotide sequence selected from the group consisting of
   (a) SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89; and
   (b) the complements of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89.

2. A nucleic acid construct comprising an isolated reproduction-specific nucleic acid molecule according to Claim 1 operably linked to at least one regulatory sequence.

3. A host cell comprising a nucleic acid construct according to Claim 2.

4. An isolated reproduction-specific nucleic acid molecule comprising a portion of a nucleic acid molecule having a nucleotide sequence selected from the group consisting of:
   (a) SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89; and
   (b) the complements of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89,

wherein said portion is at least 14 contiguous nucleotides in length.

5. A nucleic acid construct comprising an isolated reproduction-specific nucleic acid molecule according to Claim 4 operably linked to at least one regulatory sequence.

6. A host cell comprising a nucleic acid construct according to Claim 5.

7. An isolated reproduction-specific nucleic acid molecule comprising a nucleic acid molecule which hybridizes under high stringency hybridization conditions to a nucleic acid molecule having a nucleotide sequence selected from the group consisting of:

(a) SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89; and

(b) the complements of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89.

8. A nucleic acid construct comprising an isolated reproduction-specific nucleic acid molecule according to Claim 7 operably linked to at least one regulatory sequence.

9. A host cell comprising a nucleic acid construct according to Claim 8.

10. An isolated reproduction-specific nucleic acid molecule comprising a nucleic acid molecule having a nucleotide sequence which is at least 70% identical to a nucleotide sequence selected from the group consisting of:

(a) SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89; and

(b) the complements of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89.

11 A nucleic acid construct comprising an isolated reproduction-specific nucleic acid molecule according to Claim 10 operably linked to at least one regulatory sequence.

12. A host cell comprising a nucleic acid construct according to Claim 11.

13. An isolated reproduction-specific nucleic acid molecule which encodes a protein having an amino acid sequence selected from the group consisting of SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 51, 53, 57, 60, 63, 65, 68, 70, 72, 76, 78, 80, 82, 84, 85, 88, and 90.

14. A nucleic acid construct comprising an isolated reproduction-specific nucleic acid molecule according to Claim 13 operably linked to at least one regulatory sequence.

15. A host cell comprising a nucleic acid construct according to Claim 14.

16. An isolated variant reproduction-specific nucleic acid molecule comprising a nucleic acid molecule having the nucleic acid sequence of SEQ ID NO: 89 having one or more alterations selected from the group consisting of A320G, T325A, C381T, G400A, A491G, G1282A, C1449A, T2219C, A2250T, T2295C and T2472C.

17. A nucleic acid construct comprising an isolated reproduction-specific nucleic acid molecule according to Claim 16 operably linked to at least one regulatory sequence.

18. A host cell comprising a nucleic acid construct according to Claim 17.

19. An isolated variant reproduction-specific nucleic acid molecule comprising a nucleic acid molecule having the nucleic acid sequence of SEQ ID NO: 50 having one or more alterations selected from the group consisting of the alterations shown in Figure 112.

20. A nucleic acid construct comprising an isolated reproduction-specific nucleic acid molecule according to Claim 19 operably linked to at least one regulatory sequence.

21. A host cell comprising a nucleic acid construct according to Claim 20.

22. An isolated protein comprising an amino acid sequence selected from the group consisting of SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 51, 53, 57, 60, 63, 65, 68, 70, 72, 76, 78, 80, 82, 84, 85, 88, and 90.

23. An isolated protein comprising a portion of an amino acid sequence selected from the group consisting of SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30, 32, 34, 36, 38, 40, 42, 44, 46, 48, 51, 53, 57, 60, 63, 65, 68, 70, 72, 76, 78, 80, 82, 84, 85, 88, and 90, wherein said portion is at least 7 contiguous amino acids.

24. An isolated protein encoded by a nucleic acid molecule according to Claim 1.

25. An isolated protein encoded by a nucleic acid molecule according to Claim 4.

26. An isolated protein encoded by a nucleic acid molecule according to Claim 7.

27. An isolated protein encoded by a nucleic acid molecule according to Claim 10.

28. An isolated protein encoded by a nucleic acid molecule according to Claim 13.

29. An isolated protein encoded by a nucleic acid molecule according to Claim 16.

30. An isolated protein encoded by a nucleic acid molecule according to Claim 19.

31. An antibody which specifically binds a protein according to Claim 22.

32. An antibody which specifically binds a protein according to Claim 23.

33. An antibody which specifically binds a protein according to Claim 24.

34. An antibody which specifically binds a protein according to Claim 25.

35. An antibody which specifically binds a protein according to Claim 26.

36. An antibody which specifically binds a protein according to Claim 27.

37. An antibody which specifically binds a protein according to Claim 28.

38. An antibody which specifically binds a protein according to Claim 29.

39. An antibody which specifically binds a protein according to Claim 30.

40. An isolated protein comprising the amino acid sequence of SEQ ID NO: 90 having one or more alterations selected from the group consisting of W109R, V134I, G164R, N483K and V740A.

41. An antibody which specifically binds a protein according to Claim 40.

42. A method of diagnosing infertility associated with alteration of a gene having a nucleotide sequence selected from the group consisting of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89, and whose alteration is associated with infertility, comprising the steps of:

a) obtaining a DNA sample to be assessed;

b). processing the DNA sample such that the DNA is available for hybridization;

c) combining the DNA of step (b) with nucleotide sequences complementary to the altered nucleotide sequence of said gene, whose alteration is associated with infertility, under conditions appropriate for hybridization of the probes with complementary nucleotide sequences in the DNA sample, thereby producing a combination; and

d) detecting hybridization in the combination,

wherein presence of hybridization in the combination is indicative of infertility associated with an alteration of said gene.

43. A method according to Claim 42, wherein infertility is a result of reduced sperm count, reduced sperm motility, malformed sperm, or combinations thereof.

44. A method of diagnosing infertility associated with alteration of a gene having a nucleotide sequence selected from the group consisting of SEQ ID NOS: 1, 3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49, 50, 52, 54, 55, 56, 58, 59, 61, 62, 64, 66, 67, 69, 71, 73, 74, 75, 77, 79, 81, 83, 86, 87 and 89, and whose alteration is associated with infertility, comprising the steps of:

a) obtaining a DNA sample to be assessed;

b) processing the DNA sample such that the DNA is available for hybridization;

c) combining the DNA of step (b) with nucleotide sequences complementary to the nucleotide sequence of said gene, whose alteration is associated with infertility, under conditions appropriate for hybridization of the probes with complementary nucleotide sequences in the DNA sample, thereby producing a combination; and

d) detecting hybridization in the combination,

wherein absence of hybridization in the combination is indicative of infertility associated with an alteration of said gene.

45. A method according to Claim 42, wherein infertility is a result of reduced sperm count, reduced sperm motility, malformed sperm, or combinations thereof.

Figure 1

SEQ ID NO.:1 Spg1 cDNA sequence

acactcaatctccaagtgtggaaaaagaagtgaagagactgctctactcagatgctgaa
gctgtcagtgtccgctgggaagtcgttgatgatgatgatgctaaggaaatagaaagtca
agggtccATGCCAACCACTCGAGGGGCTCGAGGCCCACCGACTCCCGGCAGGGCCAAGT
CTCAGAAGACCCCCCGCCAGGGCACTGCTCGCTGCCAGACCCTCGAGAGTGCCATGCGA
TCCATGAGTGTAAGGCTTGAATGTCATGACGTTGAGGAACAGTTTATATTGCGTCTGCC
TCCGGAACAAGCTTATGCTGTCAGGAAAATTATACATTCTAGAAATGCTGCTTGGAAGG
ATAAACTAAAAATTGACTTTTCTCCTGATGGCCACCATGCGGTTGTTCAAGTAGACAAC
GTCTCACTGCCTGCTAAACTGGTTAATCTGCCTTGTGTTATCGGAAGCCTGAAAACTAT
TGACAGAAAGACATTTTATAAGACCGCGGATGTTTCTCAGATGCTTGTATGCAGTCCTG
AAGGTGAGCCTCATTCTCCTCCTGAAGAACCAGTTGTCTCTACTGGTCCTACTGTAATT
GGAATTAGTGAAGGGAAGGCAGAGAGAAAAAAATATAACTGGAAGCATGGCATTACTCC
ACCACTTAAGAATGTCAGAAAGAAAAGGTTCCGGAAAACAACAAAAAAGCTCCCAGATG
TGAAACAAGTGGATGAAATCAACTTTAGTGAGTACACTCAATCTCCAAGTGTGGAAAAA
GAAGTGAAGAGACTGCTCTACTCAGATGCTGAAGCTGTCAGTGTCCGCTGGGAAGTCGT
TGATGATGATGATGCTAAGGAAATAGAAAGTCAAGGGTCCATGCCAACCACTCCAGGAA
TCTCACAGATGGGTGGTGCTAGTTTATCAGACTATGATGTGTTTCGGGAGATGATGGGT
GATTCTGGCAGCAACAGTAATGATGTGGAAGAGAAGAGTAATGAAGGTGACGACGATGA
TGATGAAGATGAAGATGATGAAGACTATGGAAATGAAAAGGAGGAGGAAGAGACAGACA
ATTCTGAAGAGGAGTTAGAGAAGGAGCTGCAGGCCAAATTTAATGAATTTAGCCTCCAT
GAAGCAGACCAAGATTACAGTTCAATAACCATGGCAATTCAGAAACTGATTTTTATCAA
AGAAAAGAGGCTCCAGATGATTTATAAAAAAGCCCAGCGACAGAAGGAACTCCTCAGGA
AAGTGGAAAACTTGACCCTCAAGAGACATTTCCAGAATGTTTTGGGGAAGCTTAACATA
ATGGAAAAAGAGAAGTGTGAACAGATTTATCACCTCCAGGAACAACTGAAATGTTTCCT
GAAGGAGTAAggaaagcctcagcctggcacaccaagtggattcaccctccagatgaaga
ctgggtggaaccacatacttctgtccctctactttatcttaaacaacttttatttgttg
agcatttttcactaaagtaaatttaaggatcacatttatataggagacatatatagagg
gagttatataaatgcataggtttagagacccacatgggatgttgtttctctttgtcaat
ttgagattaaatgtgtgtatttctttatctcttactctatggtaccatgagatcattca
gccgtccttgtcaaaggtttaggctagaaagatacacagctgttttacataagtttact
tttcaaacctggttttaagtatttcttacaattttgaaaatgatcaaattgtcagctgg
caatcccagcaatttaaaaggcagaagcagaaggtcaaattgaaggccagcctgggctg
tatataagaccctgtctcaaaataaaataaactgaaaaccaaaaaaaaaa

Figure 2

SEQ ID NO.:2 Spg1 encoded protein sequence

MPTTRGARGPPTPGRAKSQKTPRQGTARCQTLESAMRSMSVRLECHDVEEQFILRLPPE
QAYAVRKIIHSRNAAWKDKLKIDFSPDGHHAVVQVDNVSLPAKLVNLPCVIGSLKTIDR
KTFYKTADVSQMLVCSPEGEPHSPPEEPVVSTGPTVIGISEGKAERKKYNWKHGITPPL
KNVRKKRFRKTTKKLPDVKQVDEINFSEYTQSPSVEKEVKRLLYSDAEAVSVRWEVVDD
DDAKEIESQGSMPTTPGISQMGGASLSDYDVFREMMGDSGSNSNDVEEKSNEGDDDDDE
DEDDEDYGNEKEEEETDNSEEELEKELQAKFNEFSLHEADQDYSSITMAIQKLIFIKEK
RLQMIYKKAQRQKELLRKVENLTLKRHFQNVLGKLNIMEKEKCEQIYHLQEQLKCFLKE

Figure 3a

SEQ ID NO.:3 Spg2 cDNA sequence

GAGACGGAGACGGAGTCGGAGACGCGAGACGCCAGCAAGCGTTTCGGGTGTGGGAGAGC
AGACGCCTCCCTGTTTAACAACTTTCTCCTGGATTTGCAGCTTCCTCAACGTCCCTGCA
CCTTCAGGCTGGAGCCAGACATTTAAAAAATGGACCGCATTACTGACTTTTACTTCTTG

Figure 3b

GACTTCAGAGAATCTGTTAAAACCCTGATCATAACTGGTAATTCATGGAGACTACAAGA
AATGATTGACAGATTCTTCACAAACATATCAAATTTCAACAGAGAGTCTCTGACTGAAA
TACAGAATATTCAGATTGAAGAAATTGCAGTGAACCTGTGGAACTGGGCAGTTACTAAG
AGAGTAGAACTGTCTGTGAGGAAAAACCAGGCAGCTAAACTGTGTTATATTGCTTGCAA
GCTGGTATATATGCATGGAATGTCAGTCTCTTCAGAAGAAGCTATTCAAAGACAGATTT
TGATGAATATAAAAACAGGAAAAGAGTGGTTGTATACTGGAAATGCTCAGATTGCTGAT
GAATTTTTTCAAGCTGCCATGACTGATCTGGAGAGATTATATGTCAGATTAATGCAGAG
CTGCTACACCGAGGCCAACGTGTGTGTGTATAAGATGATTGTTGAGAAAGGCATCTTCC
ATGTGCTTTCTTACCAAGCTGAGTCAGCTGTTGCTCAAGGGGATTTCAAGAAAGCATCT
CTGTGCGTCTTACGTTGCAAAGATATGCTGATGAGACTCCCTAACATGACAAAATATCT
TCATGTACTCTGTTACAACCTTGGCATAGAAGCAAGCAAGCGGAATAAATACAAAGAGA
GTTCATTCTGGCTTGGCCAAAGCTATGAAATTGGGAAGATGGATAGGCGTTCTGTTGAG
CCACAAATGCTGGCTAAAACGCTGCGGTTACTAGCCACTATTTATTTGAATTGTGGTGG
CGAAGCATATTATACCAAGGCCTTCATTGCTATACTCATTGCAAACAAGGAACATTTAC
ATCCAGCTGGGCTTTTCTTAAAGATGAGGATCCTCATGAAAGGCAACTCATGTAATGAA
GAACTCCTTGAAGCTGCTAAGGAAATACTATATCTTGCTATGCCTTTGGAATTCTATCT
GAGCATTATTCAATTCCTGATAGATAATAAAAGAGAGTCTGTTGGGTTTCGCTTTCTGA
GAATCATCTCTGACAATTTTAAGTCGCCAGAAGATAGGAAGAGAATTCTGTTGTTCTAC
ATTGACACGCTTTTACAAAAGGATCAAGACATGATTGCTGAAGAGAAGATTAAAGACGT
CCTTAAAGGTTACCAAACAAGAAGTCGACTGTCAAGAGATTTGGTAAATTGGTTACACA
ACATTCTGTGGGGAAAGGCTTCCAGAAGTGTTAAGGTCCAAAAATATGCTGATGCCCTA
CACTGGTACAGTTATTCTCTGAAGTTGTATGAGTATGATAAAGCAGATCTGGATTTGAT
CAAGCTGAAGAGGAACATGGTTTCCTGTTACTTATCTTTGAAACAACTTGATAAGGCTA
AAGAGGCCATAGCAGAAGTTGAGCAAAAGGATCCTACACATGTTTTCACTCGGTATTAT
ATATTCAAGATCGCAATCATGGAGGGTGATGCTTTCAGAGCTTTACAGGTGGTCAGTGC
TTTAAAGAAATCATTAATGGATGGAGAATCAGAAGATCGTGGACTAATTGAAGCTGGAG
TTTCAACTCTCACAATCCTAAGTTTATCTATAGATTTTGCTCTAGAGAATGGACAGCAA
TTTGTGGCAGAAAGAGCTTTGGAATATTTATGTCAACTTTCAAAAGACCCAAAAGAAGT
ACTTGGAGGTTTAAAGTGTCTCATGCGGATTATTCTTCCACAAGCTTTTCATATGCCAG
AATCTGAATATAAAAAGAAAGAAATGGGTAGACTTTGGAACTACTTGAATACAGCACTC
CTGAAATTTTCTGAATATTTTAATGAAGCTCCCTCAACTTTGGATTATATGGTTAATGA
TGCCAATTGGTTCAGGAAAATAGCTTGGAACTTAGCTGTGCAATCTGAGAAGGATCTAG
AGGCAATGAAAAACTTTTTCATGGTTTCTTATAAGCTGTCCCTTTTTTGTCCTTTGGAT
CAAGGACTACTGATTGCACAGAAAACGTGTTTACTTGTAGCAGCTGCAGTTGATCTGGA
TAGAGGAAGAAAAGCTCCAACAATTTGTGAGCAGAACATGTTACTAAGAACAGCACTTG
AGCAGATAAAGAAATGCAAAAAAGTTTGGAATCTCCTGAAAAAAACAGGGGACTTCTCA
GGTGATGACTGTGGGGTATTGCTTCTGCTCTATGAATTTGAAGTTAAAACCAAAACGAA
TGATCCATCACTGAGCAGATTTGTGGATTCAGTTTGGAAGATGCCTGATTTAGAATGCA
GAACACTTGAAACAATGGCATTACTAGCTATGGATAAACCTGCATACTATCCTACTATT
GCACATAAGGCCATGAAAAAACTTTTATTGATGTACAGAAAACAGGAGCCAGTTGATGT
TTTAAAATACAGCGTATGCATGCACAACTTGATTAAACTTCTGGTGGCAGATGAAGTAT
GGAATATATCGCTGTATCCCCTAAAAGAAGTTCAGAGCCATTTTAAAAATACTCTGAGC
ATCATTCGCCAAAACGAAGGATACCCAGAAGAGGAGATTGTATGGCTAATGATCAAGTC
TTGGAATATTGGAATACTGATGTCTAGCAAGAACAAGTATATATCTGCAGAAAGGTGGG
CTGCAATGGCATTGGATTTCCTTGGCCACCTTAGCACCCTCAAAACAAGCTATGAAGCA
AAGGTGAATCTTCTGTATGCCAACCTCATGGAAATATTAGATAAAAAGACGGATTTAAG
ATCTACAGAGATGACTGAACAATTAAGAGCACTTATTGTTCCTCCGGAGGATCAAGGTT
CAGTTTCCAGCACCAACGTGGCAGCTCAAAACCATCTGTAATTCCAGTTCCAGGGAATC

Figure 3c

TGATACTCCCCTCTGGTCACTGTGGGTACATGTGATAAAAGTAAAGAGTGATTTTACTT
TTCAGTGGAGAGTCATAATGATTGAAGGAGGTTGTAGAAAGCAGACTAGCTCACAGCAA
CTTGGAAGGTGTATATTCATGAGCCGCTGACTATTTCAGTGGTGGTGTCA

Figure 4

SEQ ID NO.:4 Spg2 encoded protein sequence

MDRITDFYFLDFRESVKTLIITGNSWRLQEMIDRFFTNISNFNRESLTEIQNIQIEEIA
VNLWNWAVTKRVELSVRKNQAAKLCYIACKLVYMHGISVSSEEAIQRQILMNIKTGKEW
LYTGNAQIADEFFQAAMTDLERLYVRLMQSCYTEANVCVYKMIVEKGIFHVLSYQAESA
VAQGDFKKASLCVLRCKDMLMRLPNMTKYLHVLCYNLGIEASKRNKYKESSFWLGQSYE
IGKMDRRSVEPQMLAKTLRLLATIYLNCGGEAYYTKAFIAILIANKEHLHPAGLFLKMR
ILMKGNSCNEELLEAAKEILYLAMPLEFYLSIIQFLIDNKRESVGFRFLRIISDNFKSP
EDRKRILLFYIDTLLQKDQDMIAEEKIKDVLKGYQTRSRLSRDLVNWLHNILWGKASRS
VKVQKYADALHWYSYSLKLYEYDKADLDLIKLKRNMVSCYLSLKQLDKAKEAIAEVEQK
DPTHVFTRYYIFKIAIMEGDAFRALQVVSALKKSLMDGESEDRGLIEAGVSTLTILSLS
IDFALENGQQFVAERALEYLCQLSKDPKEVLGGLKCLMRIILPQAFHMPESEYKKKEMG
RLWNYLNTALLKFSEYFNEAPSTLDYMVNDANWFRKIAWNLAVQSEKDLEAMKNFFMVS
YKLSLFCPLDQGLLIAQKTCLLVAAAVDLDRGRKAPTICEQNMLLRTALEQIKKCKKVW
NLLKKTGDFSGDDCGVLLLLYEFEVKTKTNDPSLSRFVDSVWKMPDLECRTLETMALLA
MDKPAYYPTIAHKAMKKLLLMYRKQEFVDVLKYSVCMHNLIKLLVADEVWNISLYPLKE
VQSHFKNTLSIIRQNEGYPEEEIVWLMIKSWNIGILMSSKNKYISAERWAAYALDFLGH
LSTLKTSYEAKVNLLYANLMEILDKKTDLRSTEMTEQLRALIVPPEDQGSVSSTNVAAQ
NHL*

Figure 5a

SEQ ID NO.:5 Spg3 cDNA sequence

cgctggcgtttgaagagagcacgaggaacggctcagtttcctggagactagacagagcg
agcgagcagccgttcagtgtagtcgttggtgtaATGTGGTCCTCTCCAAAAGAGAATCT
GCAAGGCAGGTCTTCCATGTTTGTTCAGAAGAACATTAATTCTGAGACATATAAACAAC
GATATGGTTTACCATACAAGAGATCTGAGAGATTCTATCATTCAGAATACAAAATGAAT
TATAACCATGGTTTTCAAGGAAGAAAGAGAGGTGTGAATTATATCTGGAGTCAATTTGA
CAGAAAGAACAATCATTTTGATCATTATGGTGCTCCATATGCCATGGGAATGAAAAGAA
GGAGAGAAAGATGCAGTTATGATGACCAATATTTTCTTAATGTGTGGGATGATAGTAAA
ACTGAGGAGGGCGAAACAGATCTGGATGCTGAAAATGAAACTGAGGAGAAATGGTACAA
GGTCACAATTCCCAGTGGAAGAAAGTATGAGAAGACATGGCTAATGAGGTCAATCCAGA
ACTTCTGTAGTGAGCCCTTCATCCCTGTTGATTTCCACTATGACAAAACCCAGGCCCGG
TTCTTTGTTCAGAATGCTAAGACTGCCTCTGCATTGAAGGATGTCAGCTACAGGATTTG
TGATGAAACAAGCAGAAAAATAGCGATCTTTGTCAGTCCTTCTGTTGTGCCCTATTCTG
TGCAAAACAAGTTTACATCAGAACAAATGGAGTACATAAGGGAATCTATGATGAACCGG
TATGACGCCTCCCAGAAAGCTCTGGACCTCGAAAAGTTCCGATTTGACCAGGACTTAAT
GGACAAGGATATTGACATGATGCTGAATCGAAGAAGCTGCATGGTTGCCACACTACAGA
TCATTCAAAGTGATATCCCTGAACTGTTGTCCTTGAACTTGACAAACAACAAACTGTAC
CAGCTGGATGGGCTGTCAGACATGACAGAGAAGGCCCCTCACGTTAAGATCCTGAACCT
CTCCCGAAATAAACTGAAGTCATTCACGGAATTGGAGAAGGTGAAAGAACTGAAGCTGG
AAGAGCTGTGGCTGGAAGGGAACCCCTTCTGCAACTGCTTCTTGGATCATTTTGAGTAT
ATAAGTACTATTCATGACCTATTCCCCAAGCTGTTGCGTCTGGATGGCGAGGACATAAT
AGTACCAAAAAGAAATCTTCAGAATGGCAAGGGCCTAATAGTACCGACAAGAAATCTTC
AGAATGGCAAGGACTTAATAGTACCGACAGGAAATCCTCAGGATGGCAAGGACTTAATA
GTACCGACAGGAAATCCTCAGGATGGCAAGGACCTAATAGTACCAACAGGAAATCCTCA
GGATGGCAAGGACCTAATAGTACCAACAAAAATGGACATCGAGGTCCCGCAACCATGCA

Figure 5b

AGGAAAGCTGTAACACATCTGAAGTCATAAAAAATCTAGTTCTACAATTTCTGAAAGAG
TACTACTTGTTTTATGACAATGGAGATCGACTTCGTCTTCTCGATGCTTACCATGACCA
GGCCTGCTTCTCCTTGTCAGTTCCTTTCGATGTCAGTGACCCAAACCTGAACAACTTGG
AAGAGTATTTCAAATACAGCAGAGATCTAAAGAGGCAGCAAGACTCAAGCATGCGAATG
CAGTTGCTGAAGCACACAAAACATGACATCGTGAACTCTCTTAGCTTGTTACCCAAAAC
TCAGCATGATCTTTGCTCTTTCTTGGTGGACTTGTTTCTCCACACGGAAATGATGCTCT
GTTTTTCTGTGAATGGACTATTCATGGAAGTGGAAGGAAAATGTCGAGGCTGCATCCGT
GCCTTCACGAGGATCTTCATTGCTATCCCTTGCAGCGATTCAAGAATTTGCATCATGAA
CGATGAGCTGATTGTGAGGAATGCCAGTCCCAAAGAGATACAAAAGGCCTTCACCTCAT
TGCCTGCACCCGACACGTCATTCAAGCCTTTGCTCTCTGAAGAACAGCAGGAAATGGTG
AAGTCTTTCTCTGTGCAGTCTGGAATGAAACTTGACTGGTCTCAGAAGTGCCTTCAAGA
TAACGAGTGGGACTACACCAAAGCTGGTGAGGCCTTCACTGCTCTCCAGAATGAGGGCA
AGATCCCAAAGGAATTCTTCAAATAAaggatactaaagatgtcctgtggatagagtat
tcctcctcatccacattatttccctttataagcctttcccacacctgggaatagagag
aggcctttctgaccaagaagcaaaagttaacatgtaggccaagtaatataacccccct
ccccacattggcaatttttctgtctccctccaaagttgtttgtgatttcat<u>aataaa</u>ga
gtttctttacct<u>aaaaaaaaa</u>

Figure 6

SEQ ID NO.:6 Spg3 encoded protein sequence
MWSSPKENLQGRSSMFVQKNINSETYKQRYGLPYKRSERFYHSEYKMNYNHGFQGRKRG
VNYIWSQFDRKNNHFDHYGAPYAMGMKRRRERCSYDDQYFLNVWDDSKTEEGETDLDAE
NETEEKWYKVTIPSGRKYEKTWLMRSIQNFCSEPFIPVDFHYDKTQARFFVQNAKTASA
LKDVSYRICDETSRKIAIFVSPSVVPYSVQNKFTSEQMEYIRESMMNRYDASQKALDLE
KFRFDQDLMDKDIDMMLNRRSCMVATLQIIQSDIPELLSLNLTNNKLYQLDGLSDMTEK
APHVKILNLSRNKLKSFTELEKVKELKLEELWLEGNPFCNCFLDHFEYISTIHDLFPKL
LRLDGEDIIVPKRNLQNGKGLIVPTRNLQNGKDLIVPTGNPQDGKDLIVPTGNPQDGKD
LIVPTGNPQDGKDLIVPTKMDIEVPQPCKESCNTSEVIKNLVLQFLKEYYLFYDNGDRL
RLLDAYHDQACFSLSVPFDVSDPNLNNLEEYFKYSRDLKRQQDSSMRMQLLKHTKHDIV
NSLSLLPKTQHELCSFLVDLFLHTEMMLCFSVNGLFMEVEGKCRGCIRAFTRIFIAIPC
SDSRICIMNDELIVRNASPKEIQKAFTSLPAPDTSFKPLLSEEQQEMVKSFSVQSGMKL
DWSQKCLQDNEWDYTKAGEAFTALQNEGKIPKEFFK

Figure 7a

SEQ ID NO.:7 Spg5 cDNA sequence
ATGACATACTTTTTTATTTATGTTTCCACAGAAAGAGCATGTTCTCTGAATAACTGTAC
AATTGCTAAAAGAATTGGAAAAGGAAAAGATGCTACAGTCATCTTTGAACACTTCAGGA
AACCTGTGGATCCATTTGTTCAGGAAAATTGTCCATGTAAAGCACTAAATTCAGAGATG
GGTCCTTTCAGCTCAGATACTTCTAGTTCTTATGGAAATGTACAAAATGGAAACAATTC
TGTGCTTGAAGCATACAACAGACAGACAGAAAATTCATCAAATCTTAGAGATGCTTCTC
AAGTATACACACACAATTCAGGTTTTTCTTTCATACCCACTGGTAACACAGCAAGTGGT
AATGGTGACCTGTTCAGTGTGACATATCTTAGAAGTATTTTAAGTAGTATTTCTGCTGC
TTTTCCCTCTCACAACAATACTGGCTCAAGTACAGTTATTACTTCAAAACTCATTAAGG
ACCCAAGACTTATGAAGAGAGAACAGAGCATGAGAAACAAAAGTGATACTGCAGGTTTG
AGTGATGTTTTGCCATTGGATAAGAGTTTGGGTTGTGGTGATTCACAAATAAAGCTGAC
ATGTATGCCAACTAGTTCCATCTCTTCATCGGAAGTTCCTGCTGATAATACCATTACTA
GTTGTTTGAATGCCTCTTGCTTCAAATTCTCTTCTGAAAGTTCACACTATCAGGCTCAT
AATAGCAGCTCAAAGGGCCATGACTGTATAGCATCCAGTAGCATTGCTGTTACAGAACA
ATTTAAAGAGCAACACAGTTCTTCCTTCCCCAGTTCTTTATCAAATGCATTTTCAGATG
TCAGGAAACAAAAACACAGTGAAGAACAGGTCCAGAGAGCTCAAATGAGAAGCAATGTC

Figure 7b

CCAGTTTTAACAGCTCTGAGCAGTGAGTCACGGAACTCCGATGAATCAGAAAATACTTG
TAGCAACGACTCTCAGGGTCATTTCTCTCAAGAGTCACCATCTTCTGATATAAACAGTA
TATATAAGGTTGGTCACCAGATGTCTACAGTCTTCCCAGCCCAGAAGAAAGGAAATCTA
TGTGAATACATCCAAGATACGGGAATGATGAGAGCCTCCATCAGCACAGAAGACAGCAC
TAAAGATGGAGTAAACCATACTTGGTGCAAAGAAACTGTTCTTAGTAATGAAACTGTTA
GTAGCCCAATTGATAATTCCAATACATTGTACCAGGAACACAAAGAAGGAGGAAATCTT
AATTCTTTAAGTGGTAATTGTGAAAAAATCGGAGTTACTCATAAGTTACAAGTGCCCAA
GTTTCCCATATCTTCCACAGGGGATAAAAATGAACTATATCGTGCAGCATTGGAATTAG
AGTGTTCTCTTACTCCAACTATAGAGTGTCTTTCACAAAAGTACCCGCAACACTCTTTG
GAGCATGAAGATAATACAAATTTTGCCATGACTCAAGGGCTAATAGAATTAAAAACAGT
ACAAAATAATCAGAACTTTGGTAACATTTTGTCTGATGCCTTCCAGGAAGCAAAAGATG
TTCCCCTGGCCAGTGAAAAGCTCATTGATAGAGTTATTTCATCAGCTGCCATTGACATC
TCTCTTGAGAGTTCAGTTTGCAACATAATTGGAGAATATACATGTGTCCGGAGGGAAAA
TGAAAATGGGGAAGCATCACCATATAACTGTCACAAAGAAGAAGCTTCTCGTGTTAAAG
ATGGTGTGCAGGATCACAGCCTATCTTATGATGCAGAATTGAGCTGTGATCTGAACTTG
AAAATTAACTTGCAAGAACAAAGAGATGATAAAAATCCAAACGAGGCTAAAGAACACAA
TACAGATNACATAAATGGAAGTGAGAAACAAGATTGTCTTGCAAATGACCATTTCACCA
ATATAGTTGAAATGAGGGAAATTAAGAGTAACACTGAAGTAGAAATTCTGAATTCTGAA
GAATGTTTCACATTTAACTCATTTCGGGGAAAAAACGGTAAACCAGCAGAAACAGCATC
ATCAGAGAGTGAAGCTGTAGAACAAAGGCATGCACCAAATGATCAAAGAGGCCTAGAGC
ACTTGGTGTCCACATTTCCAGAAATTGAAGGCTCTTCAGTGTGTGTAGCCTCAAATGCT
ACAAAACAAATAGTTGGCACTACTGTCCTTACAGTAAGCACAAGTCTTGGGGATCATCA
AAAAGATGAGTTAAAAGAAATTTGTTCCTCTGAGAGTTCAGATTTGGGTTTAGTAAAAC
ACAGCATTTCTGAATGTGAAATTGATACTGATAAAGATAAATTACAAGACTTTCATCAG
TTGGTAAATGAGAATTCAGCTCTTAAAACTGGATTGGGAAGTGAAATTGAGGTAGATCT
TGAACATGATAATGGTTCTGTATTTCAACAAAATATGCATAGCCAGGGAAATGACCTTT
GTGAAGAATTTGAGTTATATGAGTCTCTAAAGTCTCGGATTGATTGGGAAGGCCTGTTT
GGAAGCAGTTATGAGGAAATAGAATCCTCAAGTTTTGCAAGAAGGGAGGGTACTGATCA
GCATAGTTCTACAGAATGTAACTGTGTTTCTTTCTGTTCACAAGACAAAAGAGAGCTCC
ACAACCCAATTTTTCTTCCAGATCTACAAGTTACAATTACAAACTTACTTAGTCTACGA
ATCAGTCCCACTGATGAATCTTTAGAGTTGAAAGATAATTTTTACAAACAGGTAACTGA
ATCTACAGAACCAGAAACAAATAAGGAAGGGAATGCTTCTGGATTTGGCATGTGCTCCC
AACCTTCTGGAGAAAATTCAAGTTTTTCATGTGCAAATAAGTTTGGTAATTCAGTGCAA
GAATCAGGAGATGTGAGCAAGTCTGAGAGTTCCCATTCTTCCAACTCAAGTCATAATAC
ACATGTGGATCAAGGATCTGGAAAACCAAACAATGACTCTTTGTCTACTGAACCATCTA
ATGTCACAGTAATGAATGATAAGAGCAAATGCCCCACAAAATCAAAACCTGTCTTTAAT
GATACTAGAAATAAAAAGGACATGCAATCAAGAAGTAGCAAAAGAACCCTGCATGCATC
TTCTTCCAGGGGTCAGAACATAGCCAATAAAGACTTAAGGGAGCATGAAACTCACGAGA
AGAAGAGAAGGCCAACAAGCCATGGCTCATCTGACCGTTTCTCTTCCTTATCCCAAGGA
CGAATTAAAACATTTTCGCAGTCAGAGAAGCACATTAGGAATGTACTGAATATTCTAAA
TAATGAAGCATCTTTATGTAAAAGCAAACATCTGTCCAGGAAATTGAACAAAGCTGTTC
TTCACTTAAAAAAAGCCCATAGAAGAGTTCATACATCTTTGCAGCTTATATCTAAAGTG
GGACAAAAGAGGAAGGGCCCATTACCAAAAGCATATGCAGTAATACATAATAATTTCTG
GGAAAGTTGTGATCATCAAGGTGATAGTTTGATGTCTGAAAGAAGATATTCTAAGCATT
TTTTGTCCAAAAGAAAATATGACAGACAGGGAGATAAAAGATTTTTAAGATTTGACATT
GAGGAGTCATTGACCCCGGTATCAAAGCACAGATTATATAGAACAAACAGAGAGAGGAT
TGCAGAGTGCCTTTCTAATGAAGTCATGTCTGGGCATGTTTCCAGTAGTCTTACCACTT
TCCATGTGAGAGAATTTTGTGATGAAGAACAGTTTCCAGAACCACAGTTACCTCTAGCT

Figure 7c

TATACATCTCAGAGTATAAGTCAGTTAGAATACACTAATAGCATTGTGGGAAATGAAAG
CTCTTCTGAACTTGAACATTTTTCTGAAACAAGTGGGAATATGCTTGACCCAAAAGAAA
CACTAACTGAAAAAGAATATCAGACACATACACAGTTATGTAATAGTGACTCTGCAAAA
CTTAAAAACCATACAACACATAGTATTAGGGATATAGCAAAAGAATGTAATTCTGAGGA
TAAAACAGTTCTCTGTGAAAGCAATCCAGTGTATTTAAGTTTCATAAAAGAAAACACAA
GTCATAGTCCAGATAAAAGTTATGATTCAAATTGTAAAGCCAACACTGACATACATATT
TCAGTTTTAGGCTCCAAAAAAAAGCACATTTTAAGTGTTGATATTTATGAACAAGATAA
TTGTGTATCTGATGGTGTTAAAAGTGGAGAAGCAATTTTTCCTATAGAAAAGTGTACAG
TTCCTATGGAGACCACATCAAGCATTCCTACGGAAAATATAGCAAGCAAAAGTTACACT
ATTCCTCCGGTCTCATCAATTCTAGTGACAGCTGGAGAGGAAGAATCTTCTGTAGGGGA
AAATGGACTCTTCGATGTAAATGAGAATGAGATGAATATTACTATGCATTCTAAATTAG
ATCTAACATCAGTAACTGAAGAAAGTAAAATTTGTAAGAAAAAATATGAAGAACCTATCT
TGCAATGATAGTTCTATGCTATTAAAGGAGAATATAACGGGTCCTTCAAAAAGATATAT
GGCAAAATACATTGAGGAAGAAAAAATTAGGAAAATTGAGCAAGCAGTTTACAAAAAAA
TTATTACTGAAGGATCACCTATTAGTTTTAAGTACAAAAGTCAAAATAAGATCCTAAAG
GAAAAATCATTTCATGTTAACAAGAAAATAATTACAAACAACTTGACTGATTCTCACCT
AAGCATTAAAAATTCTACTGTAGACACAATTGCTTTGAAAGACATTCCTAATCAGCTTA
AAGAAAGAAAGGAAGCAGGGCAAATTAAAGTTAATAACAACTCTCACTCTGACTGTCTC
TCCAAGCCAGCCATTGTAGAAACTAATCATAGGCCTGTTTTACATGGGAACCCTAAAGT
TGCTACTCTTCAGAAGGAATTAAAAGAACATCGCTCACCTAATTACACATCTCATGTAA
CAGAACTGTCTCAAATTTTACAGAGAGCAGATGAAGCAGCATCTCTTCAGATTTTAGAA
GAAGAGACTAAGCTTTGTCAAAATATTCTCCCTTTATTTGTTCAAGCTTTTGAAAGACA
GCAAGAATGTTCAATTGACCAAATCCTGATTTCAAGAAAGCTATTGGTAGAACAAAACT
TGTGGAATAATTGTAGACTTAAATTGAAACCATGTGCTGTTGATACTTGGGTAGAACTT
CAGATGGCAATGGAAACTATTCAATTTATTGAAAACAAAAAAAGATTCTTAGAAGGTAA
ACCAACATTCCGAAGCTTGCTTTGGTATGATGAGAGCTTGTACAGTGAACTGCTTCGCA
GGCCACGTGGATATCAACTGCAGTCCAATTTCTACCCTGGTTTTCAAGGACGACTAAAA
TACAATGCATTCTGTGAGTTACAGAATTATCATAATCAGTTAGTTGAATTCTTAACAGA
AACAAAAAAAGAAAATAATTCATATTACGCATTATTAAAATACAAACGGCAAATTAATG
AATGTGAAGCCATAATGAAGCACTATTCTGATTGCTTTGACTTTTGTCCTTCTGTTCCA
TTTGCCTGTGGAGTTAACTTTGGAGATAGTTTAGGAGACCTGGAAACCTTAAGAAAAAG
CACTCTGAAGCTGATCAGTGTACCTGGGGGCTCTCCTAAAGTCCATTCCTACCCAGGAA
AGAAAGATCATTTGTGGATCATTATAGAAATAGTCTCCTCAAAGGTTAGTTTTATCAAG
AGCAATGAAGAAATAAGTATCAAAATCTGTCTTTATGGTCTGGAGCATATATATTTCGA
TGCTGCAAAAAGTCTTGTATGGAAAGAAAAGAGCTGCTCTTTACCCAAAAAACATTCAG
AAAAGAATAGAGAAATGGAGGAAATAAATGAGAGTGCTTTTTCTAAGTTGAAGAAGATC
TATGATGTCTTATCTAAAGGTTTAAACAATGAACCCACTAGTATTGGACTTCAAGAAGA
TGCTATTATTGCTTCCAAACAATCCACTCTAGGTAGCATATCAAACTGTAGGCTGAACA
AAGCTTGGCTTTCATATCCAGATATTTCTTGTGTTGGTGAGATACTGGATCAAGCTAAA
TCTGCAGACCTAGAGGAGTTACAGGGCCTCACTCTCAGATGTACAGATCACTTAGAAAT
TTTAAAAAAATACTTTCAGATGCTGCAAGAAGATAACATAGATAATATTTTTATCATGG
AAGAAAATGTTTTGGATATGCTAAGCAACCACAACCTGGGAGCAGTCATTTTAAAGCCT
GAAGCTATTGAGATTTATATTGAAATTGTCATGATCTCAGAAACAATTCACTACCTTAA
AAATTTAATAGCAAAGAAACTGCACAACCAGAGATTTCGAGGTATGCTCTGGTTCGATT
GGTCTCTTCTTCCTGAGCTAATTGGCTGCCAAGAAGAAGTGGTTTCCCTTTCTGTTGGT
GACACCCAAACACATTGCCTTTGGAAACTGGTAGAGACTGCAATTTCTGTCCTTAAGAA
AGAGCTGGCTGTTATCTATGAATATGGTGAAGCTTCTAACTGTTCCTATGCTCTACATT
TATTCTACAGAGAACTTAAGGAACTTACAGGCGTTAAAAGGCTTCTGAATAACTCTAAG

Figure 7d

TATTCAGTTTCCACGTATATTGACTTGGTGCCACATACTGCATCTGTAAATTTTGGAAA
CACTGTGGCAGAATTAGAACATAACTACAAGCAGTTTTTTCTATTACTCAAAAATGTAA
TGTCTGTCCCTCAGAAAGATTTTGGAAAAATGGTTCATATTATAAAAGTTATGAAGACA
ATTGAACATATGAAGCTGCTAAGTGCTAAAGATACTAAATTGTCCACTCATCTTCTCTT
TCTCCAAATGCTGCGCAACAAAAGGAATGCTTTGCAACAAAACAGACAAGAAAAGATGG
AGACACCCGTTACAGAACCTGGGGAGGACAGCAGTCAACCTGGGGTTTCTGAGCAGACA
CCTCCAGGTACAGAGTGCACAGTAAAAAACATTTCAGACTCCTCTAAAAAGCGACCTGT
GACTGCAGACACATGTGAAGTCTCTCAGGGAAAAGGAAATACAGACACTGTTCCCAGTT
GGAAAAAACAAAAGGTTACCATGAAAGATGTTGGAAACATACAGACAGTATCCAAACAT
CCAAGCACTACAGGATCTCCTCCCAATGATGAAAACAAAATAGGATCAAATTCCTCTGA
CAGTCTGAAAAGCATCTCTGCATCTCCAGAAGTGGTCAAAAGACAGAGCTCAGTACTTG
GTTCAGTGTCACCTGCTGAAAGTGTACAAGACACTTGCACACCAAAGTCAGAAAGCAAA
GTAGAGCCAACAGACAGCTTACCTGATTCTTTAGCATCTCTCACTGAACAGCAGGAAAA
CTCAAATGTCATAGAGAAAAGAAATGGGAATTCTAGTGTGGCTGAAACAAATGATAAGA
AAGACTGTCCTTTAGTAACTTGTGACCAAAAGGATATAGATGCCTCTTACTCACCTGAC
CACACACCTGCACAGGAGTCCCATAAAACCCCTGTGGATCACACACAGATCTCTCCTTC
AAACCTAACAGCAGGAAATGATGACCCTCTTGTGCCTGATGCATCTCTGCTCTCAGTGT
CTGCTTCCCAGTCAGAGAAGGACGTTTATTTGAGTGGCACAGACTTTCACCATGAAAAT
AATAAAATACTAAATTTGTCTACTGAAGATTGTACAGGCACCAGCTCTCCAGAACCTGT
GTGTATCAAGGACAAAATTTCTGTCCTGCAAGTAGATAAAACACAGCCTATAAAAAGTG
AATCGCCAAAAAAAAGTATGACTGATGCTCCAAATCTCAATACTGCACCATTTGGCTCA
TATGGGAACTCAGCCCTTAATGTGAATGGAACAGTACAGCACACTCACTCTGAACAGAA
TTCAAAAGTCCTGACTCAGAAAGTTGGCCCATCCAGGAATATACCTCCACAGTCTGCAT
GTTCTCCAGTACATAATTCTTCTGCACATTCATTTGGAACTTCATATCCATACTACTCT
TGGTGTTTCTATCAGTACAGCAGCAGCAATGGCACTGCTGTTACTCACACATACCAAGG
GATGACAACATATGAGATACAACAGCCTCCTCCTCCAGTGTTGACTACAGTTGCAAGTA
CTGTTCAGAGCACACATTTCAATCGTTCATACTCTGAACATTTTAGTTACTTTCCTGGA
CAGCCACAAGCAAATTCCTTTAACCCAGGAAACGGGTATTTTCCATCTCACACGCCTGT
TTCTTACAATTACCAACAACCAGTTTATTCACAGTTTGCTTCTCATCAACCAGTCCCAC
AGGCTACATATCCTTATCCGCCTAACCCAGGTGTGCCTCCTCAAGTTCCTTGGACTTAT
GCTCCATGGCAACAGAATCCGTTTCTACGAAGGCCTTAAAAATAAATCTCTTCATACTG
AAATAAATGCAACTTAAGTTTTCTCAAGTAAAAAA

Figure 8a

SEQ ID NO.:8 Spg5 encoded protein sequence

MTYFFIYVSTERACSLNNCTIAKRIGKGKDATVIFEHFRKPVDPFVQENCPCKALNSEM
GPFSSDTSSSYGNVQNGNNSVLEAYNRQTENSSNLRDASQVYTHNSGFSFIPTGNTASG
NGDLFSVTYLRSILSSISAAFPSHNNTGSSTVITSKLIKDPRLMKREQSMRNKSDTAGL
SDVLPLDKSLGCGDSQIKLTCMPTSSISSSEVPADNTITSCLNASCFKFSSESSHYQAH
NSSSKGHDCIASSSIAVTEQFKEQHSSSFPSSLSNAFSDVRKQKHSEEQVQRAQMRSNV
PVLTALSSESRNSDESENTCSNDSQGHFSQESPSSDINSIYKVGHQMSTVFPAQKKGNL
CEYIQDTGMMRASISTEDSTKDGVNHTWCKETVLSNETVSSPIDNSNTLYQEHKEGGNL
NSLSGNCEKIGVTHKLQVPKFPISSTGDKNELYRAALELECSLTPTIECLSQKYPQHSL
EHEDNTNFAMTQGLIELKTVQNNQNFGNILSDAFQEAKDVPLASEKLIDRVISSAAIDI
SLDSSVCNEIGEYTCVRRENENGEASPYNCHKEEASRVKDGVQDHSLSYDAELSCDLNL
KINLQEQRDDKNPNEAKEHNTDKINGSEKQDCLANDHFTNIVEMREIKSNTEVEILNSE
ECFTFNSFRGKNGKPAETASSESEAVEQRHAPNDQRGLEHLVSTFPEIEGSSVCVASNA
TKQIVGTTVLTVSTSLGDHQKDELKEICSSESSDLGLVKHSISECEIDTDKDKLQDFHQ
LVNENSALKTGLGSEIEVDLEHDNGSVFQQNMHSQGNDLCEEFELYESLKSRIDWEGLF

Figure 8b

GSSYEEIESSSFARREGTDQHSSTECNCVSFCSQDKRELHNPIFLPDLQVTITNLLSLR
ISPTDESLELKDNFYKQVTESTEPETNKEGNASGFGMCSQPSGENSSFSCANKFGNSVQ
ESGDVSKSESSHSSNSSHNTHVDQGSGKPNNDSLSTEPSNVTVMNDKSKCPTKSKPVFN
DTRNKKDMQSRSSKRTLHASSSRGQNIANKDLREHETHEKKRRPTSHGSSDRFSSLSQG
RIKTFSQSEKHIRNVLNILNNEASLCKSKHLSRKLNKAVLHLKKAHRRVHTSLQLISKV
GQKRKGPLPKAYAVIHNNFWESCDHQGDSLMSERRYSKHFLSKRKYDRQGDKRFLRFDI
EESLTPVSKHRLYRTNRERIAECLSNEVMSGHVSSSLTTFHVREFCDEEQFPEPQLPLA
YTSQSISQLEYTNSIVGNESSSELEHFSETSGNMLDPKETLTEKEYQTHTQLCNSDSAK
LKNHTTHSIRDIAKECNSEDKTVLCESNPVYLSFIKENTSHSPDKSYDSNCKANTDIHI
SVLGSKKKHILSVDIYEQDNCVSDGVKSGEAIFPIEKCTVPMETTSSIPTENIASKSYT
IPPVSSILVTAGEEESSVGENGLFDVNENEMNITMHSKLDLTSVTEESKICKKNMKNLS
CNDSSMLLKENITGPSKRYMAKYIEEEKIRKIEQAVYKKIITEGSPISFKYKSQNKILK
EKSFHVNKKHITNNLTDSHLSIKNSTVDTIALKDIPNQLKERKEAGQIKVNNNSHSDCL
SKPAIVETNHRPVLHGNPKVATLQKELKEHRSPNYTSHVTELSQILQRADEAASLQILE
EETKLCQNILPLFVQAFERQQECSIDQILISRKLLVEQNLWNNCRLKLKPCAVDTWVEL
QMAMETIQFIENKKRFLEGKPTFRSLLWYDESLYSELLRRPRGYQLQSNFYPGFQGRLK
YNAFCELQNYHNQLVEFLTETKKENNSYYALLKYKRQINECEAIMKHYSDCFDFCPSVP
FACGVNFGDSLGDLETLRKSTLKLISVPGGSPKVHSYPGKKDHLWIIIEIVSSKVSFIK
SNEEISIKICLYGLEHIYFDAAKSLVWKEKSCSLPKKHSEKNREMEEINESAFSKLKKI
YDVLSKGLNNEPTSIGLQEDAIIASKQSTLGSISNCRLNKAWLSYPDISCVGEILDQAK
SADLEELQGLTLRCTDHLEILKKYFQMLQEDNIDNIFIMEENVLDMLSNHNLGAVILKP
EAIEIYIEIVMISETIHYLKNLIAKKLHNQRFRGMLWFDWSLLPELIGCQEEVVSLSVG
DTQTHCLWKLVETAISVLKKELAVIYEYGEASNCSYALHLFYRELKELTGVKRLLNNSK
YSVSTYIDLVPHTASVNFGNTVAELEHNYKQFFLLLKNVMSVPQKDFGKMVHIIKVMKT
IEHMKLLSAKDTKLSTHLLFLQMLRNKRNALQQNRQEKMETPVTEPGEDSSQPGVSEQT
PPGTECTVKNISDSSKKRPVTADTCEVSQGKGNTDTVPSWKKQKVTMKDVGNIQTVSKH
PSTTGSPPNDENKIGSNSSDSLKSISASPEVVKRQSSVLGSVSPAESVQDTCTPKSESK
VEPTDSLPDSLASLTEQQENSNVIEKRNGNSSVAETNDKKDCPLVTCDQKDIDASYSPD
HTPAQESHKTPVDHTQISPSNLTAGNDDPLVPDASLLSVSASQSEKDVYLSGTDFHHEN
NKILNLSTEDCTGTSSPEPVCIKDKISVLQVDKTQPIKSESPKKSMTDAPNLNTAPFGS
YGNSALNVNGTVQHTHSEQNSKVLTQKVGPSRNIPPQSACSPVHNSSAHSFGTSYPYYS
WCFYQYSSSNGTAVTHTYQGMTTYEIQQPPPPVLTTVASTVQSTHFNRSYSEHFSYFPG
QPQANSFNPGNGYFPSHTPVSYNYQQPVYSQFASHQPVPQATYPYPPNPGVPPQVPWTY
APWQQNPFLRRP.

Figure 9a

SEQ ID NO.:9 Spg13 cDNA sequence
AGCAATGGCGGCAGAGGCTTCGTCGACCGGGCTGGCTTCCTGTCACCTAGTGGAGAGTA
AGAGTGGAGCGCAGGGTGCCTCGGGGTGTCAGTGCACTCGGTGTGGAAGGAAGGTGTCC
GTTGCCTCCGGTGACCACCACAAGTTTCCATGTGGACATGCCTTTTGTGAACTGTGCCT
GTCAGCACCTCAAGAATATACCACAAGTAAATGCACTGACTGTGAGGTTCATACAACTG
TCAGCATGAATCAAGGTCACTACCCAGTAGATGGCTTCATCGAGGAAGATTCTTCTCTG
GAAGCCTTGCCACCGAAAATGGTAAATAACTGCTCTTCAGATCTTGAAAAGACAGTGGA
CCAGCTAATTAATGATTTAGAACATTCATCCTCCATACATAGGAATGTTTCAAACCCAT
CAGCTGTAATGTCGGAGACAGAAGAAATTGATGAAGCACTGAAGATAGCAGGCTGTAAT
TTTGAACAATTAAGTAATGCTATAAAAATGCTTGATAGCACACAAGATCAAACAAGACA
AGAGACACACAGTCTAACAGAGGCTGTGGAGAAACAGTTTGATACACTTCTTGCTTCTC
TTGATTCCAGGAAAAAGAGCTTGTGTGAAGAACTTATAAGGCGTACAGATGATTATTTA
TCAAAATTAGTAACAGTTAAAAGCTACATTGAAGAGAAAAAAAGTGATTTGGATGCAGC

Figure 9b

TATGAAGATAGCAAAAGAACTCAGATCTGCTCCTTCTCTGAGGACCTACTGTGACCTGA
CTCAGATTATCCGGACTTTGAAGTTAACATTTGAAAGTGAATTGTCACAAGTTAGTTCC
ATAATTCCAAGGAACACCCCTAGGTTGGATATAAATTGCAGTGAGGCCATCTGCATGTT
CAGCAGTATGGGAAAGATTGAATTTGAGGACTCAACAAAATGTTACCCTCAAGAAAATG
AAGATGGACAGAATGTTCAAAAGAAATTTAATAATAGAAAGGAACTCTGTTGTGATGTA
TACTCATCACTAGAAAAGAAAAAGGTAGATGCTGCTGTCCTGACTGATGAAACACCTGA
ACCTCCTTTGCAAGCAGAGGCCCCTGACAGGCATTTAGAAGGGAAAAAGAAGCAGCCAA
CAAAAGAGATGGTTGTGGTGACATCTCCTAAGACTATTGCTGTACTGCCTCAACTGGGA
TCCAGCCCTGATGTGATAATTGAGGAAATTATTGAGGAAAACCTAGAATCATGCTTTAC
AGATGATCCTATAGAGACTTCTGGATACCCAAAAAAGCCCCCTCAGAAAGAGCAGTCTG
CTCCTGTTGGATCAAAAGCAGGTTGTCCAGAGCTAGTTTTTGTAAGTCATGTAATACAT
CCTTGCCACTTCTATGTGCGGAAATATTCACAAATAAAAGATGCAACAATATTGGAGAA
GAAGATGAAGCAAGTTTGCAATAGGAGCTTACACCTTGATCCTTCAGACATTTTGGAAC
TAGGTGCAAGAATATTTGTCAACAGTATTAAGAATAGAATGTGGTGTCGAGGAATTATC
ACTGAAATAATTCCATCAAAAACTAAAAATATTAGAAAACCATGTAGTCCAACCAAATT
CTCAGTCTGTGAAATTTCACTAATACAGATATTCATGGTAGATTTTGGAAATTCTGAAG
TCCTGATCATCACAGGAGTTGGTGACACACATGAGGGACCAGAGCATGATGGTGAACAG
CATATTACACTAAGTGACTTCTGTCTGCTTCTAATGAAGTCTGAACCATACAGTGAGGA
ACTGTTGAAAGACATCCCACATTTAGCACACCTGTGCTCCTTGAAAGACATCGTCCCAT
ACAATTCAGTAAGTGAGAGAGAAAGTGATTCTCCCTCAAAGGCTGTGGAGTTTTAGTTG
TGTTGCCAGTGAAGTTGCTGAGTTGGTCTGAAAGAACCAGTTAGCCTTGACAAACACAT
TCTGATTATGAACTATTAGTGCCAATAAAAGTTGCCATAAGCCTCAGCTTCCATAACTG
AAAATATTTGTAATGAAAATTTGAGCTCAATAAAGTTCATATGAACATAATAAAATATT
CAAGTAAATACCACAAAAAAAAAAAAAAAA

Figure 10

SEQ ID NO.:10 Spg13 encoded protein sequence

MAAEASSTGLASCHLVESKSGAQGASGCQCTRCGRKVSVASGDHHKFPCGHAFCELCLS
APQEYTTSKCTDCEVHTTVSMNQGHYPVDGFIEEDSSLEALPPKMVNNCSSDLEKTVDQ
LINDLEHSSSIHRNVSNPSAVMSETEEIDEALKIAGCNFEQLSNAIKMLDSTQDQTRQE
THSLTEAVEKQFDTLLASLDSRKKSLCEELIRRTDDYLSKLVTVKSYIEEKKSDLDAAM
KIAKELRSAPSLRTYCDLTQIIRTLKLTFESELSQVSSIIPRNTPRLDINCSEAICMFS
SMGKIEFEDSTKCYPQENEDGQNVQKKFNNRKELCCDVYSSLEKKKVDAAVLTDETPEP
PLQAEAPDRHLEGKKKQPTKEMVVVTSPKTIAVLPQLGSSPDVIIEEIIEENLESCFTD
DPIETSGYPKKPPQKEQSAPVGSKAGCPELVFVSHVIHPCHFYVRKYSQIKDATILEKK
MKQVCNRSLHLDPSDILELGARIFVNSIKNRMWCRGIITEIIPSKTKNIRKPCSPTKFS
VCEISLIQIFMVDFGNSEVLIITGVGDTHEGPEHDGEQHITLSDFCLLLMKSEPYSEEL
LKDIPHLAHLCSLKDIVPYNSVSERESDSPSKAVEF*

Figure 11a

SEQ ID NO.:11 Spg14 cDNA sequence.

acgcgggggagtccgcacctgtggctgttgggtccgcggctatggcgccaaagctctga
agccttaacggctttctcgcctggctggtgggctttctccgagttgagggccatctcct
tcgattccaagtgtgggtttcggcccagtggacccctctgctcaccATGGCAGAACCTG
CAACTGCAGAAGGAACTTCTGGTCTTGGACAACAGGTTACTAAACGGGGACACCCCAGT
ACAGGGGAAATGGAGCCTGCCACTGGAGTGCAACTTGCTGGTTCTGGAGAGCTGGTTGC
TGAACCGGGACCCTCCAGTACAGAAGCAAGGGAAAATACAGAAGAGGCGAATACCATGG
GGCAAACAGCGAATGAAGATCATTTTGACTGGGACAAGTACTTGAAAGAGACTGGATCG

Figure 11b

ATGAGTGCTCCTTCTGAATATTTCAGACAGTCTAAGACTCCACCAACTAATGAATTCAA
AATTGGTATGAAATTGGAAGCCCGTGACCCTCGCAATATTGATTCGGTGTGTGTTGCTT
CGGTCATTGGAATTACTGGAGCCAGGTTACGTCTACGACTGGATGGTAGTGACAATAAG
AATGATTTTTGGAGACTTGTGGATTCATCAGACATACAACCTGTTGGGACGTGTGAACA
AGGAGGAGATTTACTTCAGCCTCCACTGGGGTACACACTGAATACTTCATCATGGCCCA
TGTTCTTACTACGTGTACTAACTGGATCTGAACTGGCACCTGCAGTGTTCTTTAAGGAG
GAACCACCACGTCCACTCCAAAATAATTTCATAGTTGGGATGAAGATTGAAGCTGTCGA
TAGAAAAAATCCATTTATGATCTGTCCTGCCACAATTGGAGCTGTCTGTGGAGATCAAC
TTCATATCACTTTTGATGGATGGAGTGGAGCATTTGATTATTGGTGTGACTATGACTCC
CGAGACATCTTCCCAGTTGGATGGTGTCGCCTCACAGGAGATGTATTACAGCCACCAGG
AAAAATTGTTGAAAAAAGACCAAGGCGCAAAAGAAGAACCAGACTATGGAGACTTAGAA
CTGCTCTTTTGGGAAATGAAGAAGAGGCCCCAGAAGCTGCAGAAGAACCTGGGACCAGT
GTACTTACTTTTGGAGATGAAAACAGAACTTTGAAAGATTGCCGAGGAGAAGCTGCAGA
AGAACCTGGGACCAGTGCATTTACTTTTGGAGATGAAAACAGAACTTTGAAAGATTGCC
AAGGAGGTTGGAAAAAACCCAAGGGCAGAGGATTCATCAAACCTGGAAAAGATGAAACC
AGACCTGGGAAACATGACCAAGGAGCCCCAGCTGGGAAAAAACCCAGGGGCAGAGGATT
CACCCAACCTTTGGAAGATGAAGCCAGACCAGGAAGAGATGTCCAAGTAGCCCCAGCTG
AGAAAAAACGCAAGGGCAAAACAGTCACCACACCTTGGACTGAGGATCCCAGACTTTTT
GCAGATCAAGGAGATGCCCCAGCTGAGAAAAAACGCAAGGGCAAAACAGTCACCACACC
TTGGACTGAGGATCCCAGACTTTTTGCAGATCAAGGAGATGCCCCAGCTGAGAAAAAAC
GCAAGGGCAAAACAGTCACCACACCTTGGACTGAGGATCCCAGACTTTTTGCAGATCAA
GGAGATGCCCCAGCTGAAAAAAAAACCCAAGGGCAAAAGAGTCACCAAATCTCGGAAAGA
CCAAGCCCAGTTTTTAGCTGATGAAGAAGCAATGCCAGCTCTTTTTTCAGCTCTTAGTG
TGAGCAGTACAGAGAGAACACCACCTTCTTCCTCTGAACAACCAAAGTCTTCTACCTCT
GGGAAAACAAAATCCACCTCTAGAGGGGCTCAAACTTCAAGGAAGTCTCCACGGAAAAC
AAGTGTTGTGCAACCAGTACCAAAGACCAGCAAGAAAGCAGGAAAATCTAAGTCTACTG
GAAATACTTCATCCCCTAAGAAGGGCATTACTATTAAAATTGTCCTACCAAAGAAAAAG
GGTGGAAAGTCTGGAAAAAAGGAAAAAAGTATTCCAGTTATTTCTTCTACATCTTCAGC
TTCTTTAAGTACACTGATGAAAAGTTCTTCATCTAATAAGACTTCTGCGGGGCCATCTA
AAATAGTGATGTCTACAGTTTGTGTGTATATAAATAAACATGGAGATTGTGGCCCCTTC
CTGGATCCACAGAAGGTTCAGCAGCTACCTAACCACTTCGGTCCAGGCCCTGTGAATGT
CATTCTCCAGCGGACTGTGCAGGCCTGTGTCAATTGTGCCTTTCAGGCCAAGGATGTGT
TTCTATTTCTTAAAACAGATAATAGAGGAGGAGAAATGATAACTGCCTTCTTTGATGGG
AAAGTTCATACTGTTCAGCTCCCTCCAGTGAATAGTGCATCATTTGCACTTCGCTTTCT
TGAAAATTTCTGCCAAAGCCTGCAGTGTGATAACTTTTTGAGTAGCCAGCCTTTCAGAC
GTGAGGCTCAAGTTCCTACCCCAGATACAGGCACTGATCAAAGCAAACCAGAAAATGGG
GAACCAAAGGAAAAGAGAAGCCTCAAACGATTGTCTCTGCATCCTCATCGTTCTGCTCC
TGTCTCATCTAAGGTTCCCAGAAAGTCTGGGCAAGCGTCTAAAGGAAATTGAtgggaaa
gctctgctactactgaagagtgagctgctgatgaagtatatggggctgaaactaggacc
agcagtaaaactttgttattacattgaaaaacttaaagaaataaaccataattgaaaat
gtgcaaatttagtttagagataattctcaggtatactgaaaacatttttactttaatagt
agttttcatctcatccgtttttattttatagaatgtttttatagaaatatttttatgaaa
gttgtagtacattaatagtatactcttattctttaaattccatctaatacgttttgtatt
agcatgattaaaactggct

Figure 12a

SEQ ID NO.:12 **Spg14 encoded protein sequence**
MAEPATAEGTSGLGQQVTKRGHPSTGEMEPATGVQLAGSGELVAEPGPSSTEARENTEE
ANTMGQTANEDHFDWDKYLKETGSMSAPSEYFRQSKTPPTNEFKIGMKLEARDPRNIDS

Figure 12b

VCVASVIGITGARLRLRLDGSDNKNDFWRLVDSSDIQPVGTCEQGGDLLQPPLGYTLNT
SSWPMFLLRVLTGSELAPAVFFKEEPPRPLQNNFIVGMKIEAVDRKNPFMICPATIGAV
CGDQLHITFDGWSGAFDYWCDYDSRDIFPVGWCRLTGDVLQPPGKIVEKRPRRKRRTRL
WRLRTALLGNEEEAPEAAEEPGTSVLTFGDENRTLKDCRGEAAEEPGTSAFTFGDENRT
LKDCQGGWKKPKGRGFIKPGKDETRPGKEDQGAPAGKKPRGRGFTQPLEDEARPGRDVQ
VAPAEKKRKGKTVTTPWTEDPRLFADQGDAPAEKKRKGKTVTTPWTEDPRLFADQGDAP
AEKKRKGKTVTTPWTEDPRLFADQGDAPAEKKPKGKRVTKSRKDQAQFLADEEAMPALF
SALSVSSTERTPPSSSEQPKSSTSGKTKSTSRGAQTSRKSPRKTSVVQPVPKTSKKAGK
SKSTGNTSSPKKGITIKIVLPKKKGGKSGKKEKSIPVISSTSSASLSTLMKSSSSNKTS
AGPSKIVMSTVCVYINKHGDCGPFLDPQKVQQLPNHFGPGPVNVILQRTVQACVNCAFQ
AKDVFLFLKTDNRGGEMITAFFDGKVHTVQLPPVNSASFALRFLENFCQSLQCDNFLSS
QPFRREAQVPTPDTGTDQSKPENGEPKEKRSLKRLSLHPHRSAPVSSKVPRKSGQASKG
N

Figure 13a

SEQ ID NO.:13 Spg15 cDNA sequence

CAGCAGTGACTATGGCATGATTGACGACTTGATCTACTTTTCCAATGACGCTGTGACGA
GTACAGTGCTTCTGAACGTGGGACAGGAAGTCATTGCTGTCGTTGAAGAAAACAAAGTG
TCAAATGGACTGAAAGCAATCAGAGTAGAAGCTGTCTCTGACAAATGGGAAGATGATAG
CAAAAACTCTAGCAAAGGGTTGTCAGACTCCAGCCCCAGAGTGCTGATTGGCTGTGTGA
CTTCCATGTTGGAAGGTGCTGGCTATATCAGCCAGACCACATACTTCTCTTTGGAGAGT
GTGTGTGAAGGTTTCCACCCATGCAAGGGTGACTGGGTAGAGGCTGAGTATTGGATCAG
GCCAGGGACATGGAGCAGTGAGGCAATCTCTGTGAAGCCTCTGAGGTACAAGCGTGTGG
ACAAGGTTTGCATTTCCAGCCTGTGTGGGAGGAACGGGGTGATAGAGGACAGCATCTTC
TTCAGCCTGGACTCCTTGAAGCTGCCGGAAGGGTACATACCGAGGAGACACGACATTGT
CAATGCTGTGGTTGTGGAGAGCAGCCAGTCATGCTACATCTGGAGAGCACTGTGCATGA
CCCCTGTGAAGAGAGATGCCACTCTTGGTGAGGCCCCTCAGGAGCCCTATGGAGCACTC
TTACTGAAAAACAAAGGGGACATTGAAGTTACAAGAATGACCAGTTTTGGAACATTGAA
GGAAGGAGAAAGCAAATCAATCGTGATCTGGATAGAGAATAAAGGGAAGTTCTCTCGGG
AGCTTGTCAGTTGCAGACTGGCTAACTGGGATAAAGCACACCAGTTTAGATTTGAGACA
CAGGGCAGAAGCAAGTCCTGCCCAGGAGCGGCTGCTGGGTCTGTTCCTGAAGGTGAAAA
TGTTAATTCATTGAATCATCACAGAGAAGACAAAACTGATGAGATTCCAGAGAGCCGTC
TGGCGAACAGCACAGAAATCTCTCCAGATGGCTGCGCTTGTAAAGAAGAAAGTAGAGAA
AAAGGAAACACGCCAGAGAAACAGGAGCCAGAGCCTGGGGGGCTCATTCCTCCGGGGGA
GAAGACTCACATTGTGGTCACATGCAGTGCCAAAAACCCTGGCCGTTGCAAGGAGCTGC
TTCTGCTCTGTTTCTCCGACTTTCTCATTGGGCGGCATCTTGAAGTGAGTGTGGTGAGC
AGCGAGGAGGCCCTGATAGCTGTGCGTGAGCCGTTTTCTTGGAAGAAGCCTAAAAGCTC
CCAAACATTAGTGTCTGCAAAGACTACAGTTGTTGTAACCACACAAAAAAGGAACTCGA
GGCGACAACTTCCAAGTTTTCTTCCACAGTATCCAATACCAGATAGACTTAAAAAATGT
GTGGAGCAGAAGATTGACATCCTGACTTTCCAGCCGCTTCTTGCAGAGCTCTTGAACAT
GTCAAACTACAAGGAGAAGTTCTCCACCCTGCTGTGGCTAGAGGAGATCCATGCAGAAA
TCGAGCTGAAGGAGTACAACATGAGCAGAGTTGTCCTCAAGAGGAAGGGGGATCTGCTG
GTCCTGGAGGTCCCCGGGCTCGCAGAGAGCCGGCCTTCCCTCTATGCAGGTGACAAACT
GATTTTAAAATCTCAAGAATACAATGGACATGTCATTGAATATATCGGCTATGTCATGG
AGATTCATGAAGAAGATGTAACTCTTAAACTTAATCCAGGATTTGAACAAATGTATAAT
TTTGAACCTATGGATGTGGAGTTTACATACAATCGGACCACAAGCAGACGGTGTCACTA
TGCACTTGAGCAGGTCATCCATTTGGGTGTAAAAGTATTATTTCCAGAAGAAATCATTT
TACAGTCTCCTCAGGTGACAGGGAATTGGAGCCTTGCACAGGACACCAAAAATGATGGG
CAGTCCATCACCAACATCACCAGAAATGATGGACAGTCCATGACCAAGGTAACCAGAAA

Figure 13b

TGACAGCCAGTCCATCACCAACATCATCAGAAATGATGGACAGTCCATCACCAACGTCA
CCAGAAATGACGGGCAGCCCATCACCAAGGTAACCAGAAATAACAGCCAGTCAATCACC
AACATCACCAGAAATGACGGGCAGCCCATCACCAAGAACAAGAAAACAGTGAAGGACCA
AACTAAACACACAACAGAGGAAAGGCACGTGGGTACCACGGACCAGCCAGAGAAGGCTT
CCTCCACTGCAGAGACTATGGATGAAATCCAGATCCCAAAAGCACGAGATAAGGAGTTC
TTCAACCCAGTGCTCAATGAAAACCAAAAGCTGGCCGTGAGGAGGATCCTGAGTGGCGA
CTGCCGGCCTCTCCCATATATCCTTTTTGGACCTCCGGGAACTGGAAAGACTGTGACTA
TAATCGAGGCTGTTTTGCAGGTACATTATGCTTTGCCGGACAGTCGGATTTTGGTCTGC
GCTCCTTCCAACAGTGCTGCTGACCTTGTGTGTTTGCGACTTCATGAGAGCAAGGTGCC
GAAGCCAGCTGCCATGGTCCGGGTGAATGCCACCTGCAGATTTGAAGAGACTATTATTG
ATGCCATCAAACCGTATTGCAGAGATGGAGAAGATATCTGGAGAGCCTCACGCTTCAGG
ATAATAATCACTACATGTAGCAGTGCAGGACTGTTTTACCAAATAGGAGTGAGAGTTGG
ATACTTCACACATGTATTTGTGGACGAGGCAGGACAGGCAAGTGAGCCAGAATGCCTTA
TTCCTTTGGGACTGATTTCAGACATCAATGGCCAGATCGTGCTTGCTGGAGACCCCATG
CAGCTCGGCCCAGTCATCAAGTCCAGGCTGGCCATGGCCTATGGGTTGAATGTGTCCAT
GTTGGAGAGGCTGATGTCCAGACCAGCGTACCTGAGAGACGAAAATGCCTTTGGCGCTT
GCGGTGCATATAACCCATTGTTGGTCACAAAGCTTGTGAAGAACTACAGGTCCCACTCG
GCTCTGCTGGCACTGCCCTCACGCCTGTTCTACCATAGGGAGCTTGAGGTCTGTGCTGA
TCCCAAAGTAGTGACTTCACTGCTGGGCTGGGAGAAGCTGCCCAGAAAAGGCTTCCCTC
TCATCTTCCATGGAGTGAGGGGGAACGAGGCTCGTGAAGGGAGAAGCCCATCGTGGTTC
AGCCCAGCCGAGGCTGTCCAGGTCATGCGCTACTGTTGCCTCTTGGCCCGGAGTGTCTC
CAGTCAAGTGTCTTCCAAGGATATAGGTGTCATCACACCCTATCGGAAGCAGGTGGAAA
AAATAAAAATCCTTCTGCGAAATGTGGATTTGACTGACATAAAGGTTGGCTCGGTAGAG
GAGTTCCAGGGACAAGAGTACCTGGTCATCGTCATCTCCACTGTGCGGTCAAATGAAGA
TAGATTTGAAGATGACCGTTATTTTTGGGTTTCTTGTCCAATTCAAAAAGATTTAATG
TTGCAATCACAAGACCCAAAGCACTGCTGATCATTCTGGGAAACCCTCATGTGCTTGTC
AGAGATCCCTGTTTTGGAGCGCTGCTAGAATACAGTGTTAGCAATGGTGTCTACACAGG
GTGTGATCTGCCTCCTGAACTCCAGGCTCTCCAAAAGTGAGCGCTCCAGTCCACTTCCT
AAAAGGTAAAGCACCGTGGAGGAAAGAGTGTGGCTCCACGTGTTCACCTTAAGCAGGCT
GTGGCTAGACAGCTGTGCCAGGACCTGTGGACATGGTGCAGTCTGCTACAACAGGGAGC
CATTGAGCCTCACCCTATGGGCCATTAGTCCAGCCATGCTTCAGTCTTCTGTGACTCCT
GCGGCTTCCTGGTCTCAAGACTGAATGTTGGTATGCATGGGACCACTGAGTCAGCTGGG
CTGCTCCTGCTTCCTTGGACTGACCTTGGTTCCTAACAGTTAGTTTCTGCCTGTGGGCA
ATCACTGCCACTACACTCCCCCAAATAAACACTTCCATAACCC

Figure 14a

SEQ ID NO.:14 Spg15 encoded protein sequence

MIDDLIYFSNDAVTSTVLLNVGQEVIAVVEENKVSNGLKAIRVEAVSDKWEDDSKNSSK
GLSDSSPRVLIGCVTSMLEGAGYISQTTYFSLESVCEGFHPCKGDWVEAEYWIRPGTWS
SEAISVKPLRYKRVDKVCISSLCGRNGVIEDSIFFSLDSLKLPEGYIPRRHDIVNAVVV
ESSQSCYIWRALCMTPVKRDATLGEAPQEPYGALLLKNKGDIEVTRMTSFGTLKEGESK
SIVIWIENKGKFSRELVSCRLANWDKAHQFRFETQGRSKSCPGAAAGSVPEGENVNSLN
HHREDKTDEIPESRLANSTEISPDGCACKEESREKGNTPEKQEPEPGGLIPPGEKTHIV
VTCSAKNPGRCKELLLLCFSDFLIGRHLEVSVVSSEEALIAVREPFSWKKPKSSQTLVS
AKTTVVVTTQKRNSRRQLPSFLPQYPIPDRLKKCVEQKIDILTFQPLLAELLNMSNYKE
KFSTLLWLEEIHAEIELKEYNMSRVVLKRKGDLLVLEVPGLAESRPSLYAGDKLILKSQ
EYNGHVIEYIGYVMEIHEEDVTLKLNPGFEQMYNFEPMDVEFTYNRTTSRRCHYALEQV
IHLGVKVLFPEEIILQSPQVTGNWSLAQDTKNDGQSITNITRNDGQSMTKVTRNDSQSI
TNIIRNDGQSITNVTRNDGQPITKVTRNNSQSITNITRNDGQPITKNKKTVKDQTKHTT

Figure 14b

EERHVGTTDQPEKASSTAETMDEIQIPKARDKEFFNPVLNENQKLAVRRILSGDCRPLP
YILFGPPGTGKTVTIIEAVLQVHYALPDSRILVCAPSNSAADLVCLRLHESKVPKPAAM
VRVNATCRFEETIIDAIKPYCRDGEDIWRASRFRIIITTCSSAGLFYQIGVRVGYFTHV
FVDEAGQASEPECLIPLGLISDINGQIVLAGDPMQLGPVIKSRLAMAYGLNVSMLERLM
SRPAYLRDENAFGACGAYNPLLVTKLVKNYRSHSALLALPSRLFYHRELEVCADPKVVT
SLLGWEKLPRKGFPLIFHGVRGNEAREGRSPSWFSPAEAVQVMRYCCLLARSVSSQVSS
KDIGVITPYRKQVEKIKILLRNVDLTDIKVGSVEEFQGQEYLVIVISTVRSNEDRFEDD
RYFLGFLSNSKRFNVAITRPKALLIIIGNPHVLVRDPCFGALLEYSVSNGVYTGCDLPP
ELQALQK

Figure 15a

SEQ ID NO.: 15 Spg16 cDNA sequence

cctggctatgcggctagtatccggaggacagacggggtctcttcctgctcgctgatgt
ctctcataaggtcattcggaacgactctgtgctggatgtcATGCATGCTATCTACCAGC
AGAACAAGGAGCACTTCCAGGACGAGTGCAGCAAGCTTCTGGTTGGCAGCATTGTCATC
ACGCGCTACAACAATCGTACCTACCGAATCGATGATGTGGACTGGAACAAGACCCCTAA
AGACAGCTTTGTCATGTCGGACGGGAAGGAAATCACATTCCTGGAATACTACAGCAAAA
ACTATGGGATCACAGTCAAGGAAGATGACCAGCCGCTGCTGATCCACCGGCCCAGTGAG
AGACAGAATAACCATGGCATGTTGCTGAAGGGCGAGATCCTGCTGCTGCCCGAGCTCTC
CTTCATGACGGGGATCCCTGAGAAGATGAAGAAGGACTTCAGGGCCATGAAGGACTTGA
CTCAGCAGATTAACCTGAGCCCCAAGCAGCACCACGGTGCTTTGGAATGCCTGCTGCAG
AGAATTTCACAAAACGAGACAGCCAGCAATGAGCTGACCCGCTGGGGGCTCAGTCTGCA
TAAAGATGTCCACAAGATTGAAGGTCGGCTTCTGCCAATGGAGAGGATCAACTTAAGGA
ACACTTCATTTGTCACATCGGAGGGCCTGAACTGGGTTAAGGAAGTGACCAGAGATGCT
TCCATTCTAACTATTCCCATGCATTTCTGGGCACTCTTTTATCCAAAGAGAGCAATGGA
CCAAGCCAGAGAACTGGTTAACATGTTGGAAAAGATTGCCGGGCCCATTGGCATGCGCA
CAAGCCCCCCAGCCTGGGTTGAGCTGAAGGATGACCGAATAGAGACCTATATCAGGACC
ATTCAGTCCTTACTGGGAGTTGAGGGGAAGATACAAATGGTCGTTTGCATCATCATGGG
CACACGTGATGATCTCTATGGAGCCATCAAGAAGCTGTGCTGCGTGCAGTCCCCAGTGC
CCTCACAGGTCATCAATGTCCGAACCATTGGTCAGCCCACCAGGCTTCGGAGCGTGGCT
CAGAAAATTTTACTTCAGATGAACTGTAAACTGGGTGGTGAGCTCTGGGGAGTGGATAT
TCCGCTGAAACAACTAATGGTGATTGGAATGGATGTGTACCATGACCCCAGCAGAGGCA
TGCGCTCTGTGGTCGGCTTCGTGGCCAGCATAAATCTCACACTCACCAAATGGTACTCG
AGGGTGGTGTTCCAGATGCCACATCAGGAGATTGTGGACAGCCTGAAGCTCTGCCTGGT
GGGTTCCTTGAAAAAGTATTATGAGGTGAACCATTGTCTCCCAGAGAAAATTGTGGTGT
ACCGAGATGGAGTGTCTGATGGCCAGCTAAAGACAGTTGCCAACTACGAGATCCCTCAG
CTGCAGAAGTGTTTTGAAGCCTTTGATAACTACCACCCCAAGATGGTGGTGTTTGTAGT
TCAGAAGAAAATCAGCACCAATCTGTACCTTGCTGCTCCTGATCACTTCGTAACCCCCT
CCCCCGGGACTGTGGTTGATCATACCATAACCAGCTGTGAGTGGGTGGATTTCTACCTT
CTTGCCCATCATGTGCGACAGGGCTGTGGCATACCTACACACTACATCTGTGTTCTGAA
CACTGCAAATCTGAGCCCTGATCACATGCAGAGGTTGACTTTCAAACTATGCCACATGT
ACTGGAATTGGCCTGGTACCATCCGAGTTCCAGCTCCTTGCAAGTATGCCCACAAGCTA
GCTTTCCTGTCCGGACAGATTTTGCATCATGAGCCAGCCATCCAGCTGTGTGGGAACCT
GTTCTTCCTGTAActgggaacttggacaccggctgcaaggagcaactggactcagctca
gctcctccttacagaatcaacagaaatggcagtggaatttatgttgcattttctctt
tctccatctttgtagaattagatttctgttcttcttttaaccctgatatcatagtaggg
tgttgtggtgcatgcctttatcccagcacttgggagactgaagcaggagtatctttag
ttcaaggccagcctagactacatggtgagttctaggctagccaagattacagagtgaga

Figure 15b

ccctgtctcaaaaaacaaaaacaaaccactgtcccctcaaagcccacaacaaaaccaaa
gcctggggtcaaggaagcaagtttgtaggtagccgctggctgcccgctgccttcatgga
gtgtgtgccgtcagcgctgcttctcctcagccgagcgtggagcttcggacagggcagtg
atgacatgttcttagcatgtcaaatccccctaccaaataagtcaaacaaggaaaaaata
gcccccaaggcagcctgagcatcagttcctagaggttatgcctacagaaccatcctatt
tctggtggcagaagtgacatgaagtcattgcagacatcttaaaggagagttactgtgca
gctgtctacatgtgtgaaagacatgtagaaaaaccagcgtagggtacagtcgggcgtat
gtgcccacctgacccagggctgtgagtctgacttcccgagagtctggctagagctgctt
ttctggtcccttttggttatttgcaaccatcatcagattgctttcctgcagcccgactga
tacacgcatgtgcgcacgcacacactttttgttctttgtgactaatcttgaataaattca
attagaacacatggaaaggattcagcagacctaggaacatttggggtggagtgtagttt
ttctgcaaaagtctgtaaatgagattacgcaagagtctcttccagctgtgggctggtgt
tgcttggaaaatttcaaaatcccaaagtttcaggcttcccaaagttggcttggaaaaat
gtgatagtctcacctgagtctagacatgtaggaaatttttcctagggcctctgggcttca
gtatttggggaagcactggttttctgtgttatttttttccttctgtttcagaatcttc
aagtttcttcaggcttcagtgggccatccctttactgggctctaaaagctaattttact
taacctttcaaatgtgtatgtatcgatttatgttttggtgtggtggatggatggtagg
ggactgagcagaaatagtcattttaaataacagtgtgctaggagagcctcagtgtgaag
tcctgaggagcagcgggggctgtgggagtcagtgtcagccctcactcagacaggccaag
cctgggctcgaagacaacattgtccaggaagcctttagtttgctatagcacccagagg
ttggcgaggaataagggttagggtcctcaaatacacccatggctttggagtctatgac
caaggccaggctgagacctgaaatgtaaaagccatagaattaaacagaacagactgaaa
aacgagtcttaagttccactttctggatttctctggaagtcttttgaatttgtctgtag
aagttgctgttcctagcactccttttctctttaggtagaacagatacttgaccataatg
ccagaatgtactttttctgccttggtttttttatgccttgtttttcagtttcagggcca
aacaattgggccctgtggtgtaa<u>aataaa</u>aacaatgtatgtgtat<u>aaaaa</u>

Figure 16

SEQ ID NO.:16 Spg16 encoded protein sequence

MHAIYQQNKEHFQDECSKLLVGSIVITRYNNRTYRIDDVDWNKTPKDSFVMSDGKEITF
LEYYSKNYGITVKEDDQPLLIHRPSERQNNHGMLLKGEILLLPELSFMTGIPEKMKKDF
RAMKDLTQQINLSPKQHHGALECLLQRISQNETASNELTRWGLSLHKDVHKIEGRLLPM
ERINLRNTSFVTSEGLNWVKEVTRDASILTIPMHFWALFYPKRAMDQARELVNMLEKIA
GPIGMRTSPPAWVELKDDRIETYIRTIQSLLGVEGKIQMVVCIIMGTRDDLYGAIKKLC
CVQSPVPSQVINVRTIGQPTRLRSVAQKILLQMNCKLGGELWGVDIPLKQLMVIGMDVY
HDPSRGMRSVVGFVASINLTLTKWYSRVVFQMPHQEIVDSLKLCLVGSLKKYYEVNHCL
PEKIVVYRDGVSDGQLKTVANYEIPQLQKCFEAFDNYHPKMVVFVVQKKISTNLYLAAP
DHFVTPSPGTVVDHTITSCEWVDFYLLAHHVRQGCGIPTHYICVLNTANLSPDHMQRLT
FKLCHMYWNWPGTIRVPAPCKYAHKLAFLSGQILHHEPAIQLCGNLFFL.

Figure 17a

SEQ ID NO.:17 Spg17 cDNA sequence

ggaaggATGTCGGAAGCTGAGGCAAGCAGTGGGATGGCCCACAACGCTGGACCTGATGA
GAAGACATTGCAGGTGTTGCGGGACATGGCCAACCGCCTGCGAATCCGTTCCATCAGGG
CCACAAATTCCTCGACCACTAGCTATCTCATACCATGCAGCAATGCTGAGATCATGTCT
GTGCTGTTCTTTTATACAATGAGATATAAACAAGAAGACCCCGAAAACCCAGACAATGA
CCGGTGCATCCTTTCAAAGGGACTACCATTTGTTAATGTGGCAACAGGATGGCCTGGAC
AAGGACTAGGGGCTGCCTGTGGGATGGCATATACTGGCAAGTACTTTGACCAAGCCAGC
TACCGGGTGTTCTGTCTTCTGGGGGATGAGGAATCCACAGAAGGCTCTGTTTGGGAGGC
ATTTGCCTTTGCATCCTACTACAATTTGGACAATCTTATGGCAATCTTTGATGTGAACC

Figure 17b

GCATTGGACACAGTAGCTCCATGTCTGTTGAGCACTGCATTGCCATCTACCAGAAGCGT
TGTGAAGCCTTTGGGTGGAATACTTACGTGGTGGATGGCCGTGATGTCAAGACCCTGTG
CCATGTATTCTCACAGGCAGCTCAAGTGAGAGGCAAGCCCACTGCTGTGGTTGCCAAAA
CCTTCAAGGCCCGAGGCATGCCAAATGTTGAGGATGCGGAAAGTTGGTATGGAAGGCCA
ATGCCAAAAGAAAGAGCAGATGCAATTGTCAAGTTAATTGAGAGCCAGATACAGACCAA
CAAAATTCTTGTACCATCACCCCCTATTGAGGACTCGCCTCAAATTAACATCATGAATA
TATGTATGACTTCGCCCCCTGTTTACGTAGCTGATGACAAGGTGTCTACTCAAAGAGCA
TGTGGTTTGGCTCTAGCTAAACTGGGCCATGAAAATGACAGAGTTATTGTGCTGGGTAG
TGACACCAAGAACTGCAATTTTTCTGACATATTCAAGAAAGAACACCCAGAGAGATTCA
TCCAGTGTTGTATTGCTGAACAAAACATGGTAAATGTGGCTCTAGGATGCTCCACCCGT
GACCGGACCATTGTTTTTGCTTACTCCTTCGCTGCCTTTTTCACCCGAGCATTTGATCA
GATCCGATTGGGAGCCATCTCTCAAATCAACATCAACCTTATTGGTTGTCACTGCGGGG
TATCTACTGGTGATGACAACCCTTACCATATGGCCCTGGAAGACCTGGCCATGTTCCGA
GCAATTCCCAATTGTGTTGTTTTCTATCCAAGTGATGCCGTCTCCACAGAACATGCTGT
TTACTTAGCAGCCAATACTAAGGAAATGTGCTTTATTCGTACCAGCCAAGCAGAAACTG
CAATTATTTACACCACTCAAGAAACCTTTCAGATTGGACAGGCCAAGGTTGTCCGCCAT
AGTGACAATGACAAGGTCATAGTTATTGGAGCAGGAGTCACCCTGCATGAAGCCCTAGT
AGCTGCTGCTGAGCTCTCTAAAGAAGATATATCTATCCGTGTCATTGACTTGTTTACCA
TTAAACCTCTGGACATTGCCACCATCATTTCCAATGCAAAAGCCACAGGTGGCCGAATT
ATCACCGTGGAGGATCACTATCCTGAAGGTGGCATTGGAGGAGCTGTCTGTGCAGCAGT
CTCCATGGAGCCTAACATTGTGGTTCATAACCTGGCAGTAATGGATGTGCCTCGTAGTG
GAAGATGCAATGAAGCACTAGATTTTTCTGGAATCAGTTCCAGACACATCATTGTGGCT
GTGAAATGCATCTTAATGACCTAAattagctgttgtcttggtctgagaagactagcct
cttctctgtatgtttatgcttgtgccaaaaccatcaattagatagaaatgatgattgcg
ctttgttctccttaaaggcaaaaccagttaacacctttgttccacattcagaaattcta
attcccctctaatctgtgactacacatacaaatatcactgttttaaccatcaaaggggt
tataagatttataatggcagaatagataacaagacaactacctgacactgaactttctc
ataagactgaatataagtggattaaggaacaatgtagaagtgacagtttggaagtattt
tcttcataagtaaagcaaatgtgtgttgaattgtagtccgcagcccacctttcacagaa
ctagacccccgagatacatagtgctgttcaacttgagttaccatgtacactgcctgcag
gttcctgagttatgtgtaatttcagatgctcttgatttttctctgctgtttccctttat
atcccctccacagttcacaggttgatgaacagaacaaaagcagttatgatcacttgtgc
tgttgtgatgactgttctgtgaagacgtaaggacacttgatctccacactatgctgttt
gatgtt<u>aataaa</u>gcattaa

Figure 18

SEQ ID NO.:18 Spg17 encoded protein sequence

MSEAEASSGMAHNAGPDEKTLQVLRDMANRLRIRSIRATNSSTTSYLIPCSNAEIMSVL
FFYTMRYKQEDPENPDNDRCILSKGLPFVNVATGWPGQGLGAACGMAYTGKYFDQASYR
VFCLLGDEESTEGSVWEAFAFASYYNLDNLMAIFDVNRIGHSSSMSVEHCIAIYQKRCE
AFGWNTYVVDGRDVKTLCHVFSQAAQVRGKPTAVVAKTFKARGMPNVEDAESWYGRPMP
KERADAIVKLIESQIQTNKILVPSPPIEDSPQINIMNICMTSPPVYVADDKVSTQRACG
LALAKLGHENDRVIVLGSDTKNCNFSDIFKKEHPERFIQCCIAEQNMVNVALGCSTRDR
TIVFAYSFAAFFTRAFDQIRLGAISQININLIGCHCGVSTGDDNPYHMALEDLAMFRAI
PNCVVFYPSDAVSTEHAVYLAANTKEMCFIRTSQAETAIIYTTQETFQIGQAKVVRHSD
NDKVIVIGAGVTLHEALVAAAELSKEDISIRVIDLFTIKPLDIATIISNAKATGGRIIT
VEDHYPEGGIGGAVCAAVSMEPNIVVHNLAVMDVPRSGRCNEALDFSGISSRHIIVAVK
CILMT.

SEQ ID NO.:19 Spg18 cDNA sequence Figure 19

ggcacgaggcgcgaagccctcacgctcgtgctgcggctctgaggcggcaggtcgtggcc
gaatctccgcttgcgagtggggccagaggtttgtgtctccagagaatgATGGCAAACCA
CCTTGTAAAACCCGACTCTAGAAACTGCAAGAGGGCAAGAGAATTGGAGCCTCAGGTGT
CTGATAGTCCACAGGTATCTTCTCTTGGAAAATCAGAGTCATCTCTCTCTGAGGCTTCT
GGACTCTTTTATAAAGAGGAAGCTCTGGAGAAGGATTTGAGCGATATGAGCAAGGAAAT
TAATCTGATGTTGTCTACATATGCAAAGATTTTAAGTGAAAGAGCAGCAGTAGATGCAT
CTTACATCGATGAGATAGATGGACTCTTCAAAGAAGCCAATATTATTGAAAACTTTCTA
GTACAAAAAAGAGAGTTCCTGAAGCAGAGGTTTACAGTAATTACCAACACCCTACACAA
GTAAtgtgcctatgccagctaaaagtttttcctgttactgctgtgttcttcttgctaga
gaaaacatatattaaactgtaactttttctaaatttaaaagaagttttaagatagatat
taatatgaagtgtgtaatatttcttttgagggtcaaatatttggcacattatataaaaa
tataaattaaaaattatatgcatgtttttttctttattgtttattcctaaattgcttag
cccttcttaaactatgaaagaggactctgttaatttgattatgcttaacaatatttgtt
taaatagcagatgatttttgagatagttttaaagtgtttttcttgattttattataa

SEQ ID NO.:20 Spg18 encoded protein sequence Figure 20

MMANHLVKPDSRNCKRARELEPQVSDSPQVSSLGKSESSLSEASGLFYKEEALEKDLSD
MSKEINLMLSTYAKILSERAAVDASYIDEIDGLFKEANIIENFLVQKREFLKQRFTVIT
NTLHK

Figure 21a

SEQ ID NO.:21 Spg25 cDNA sequence

GCAAGAGTCAAGAGAGTGTTGGTGTGTTCAGGCCAGAGTCTCTGTTCTATACAGCAGCA
AATCCTAGGACTTGATTGCTCTCCATTCACTGTTTCTACCTGTGCTGAGTGCCTGTCCT
AAGATTCTGATAGAGGTTGTTTTCCCTTGGCATATACACACACTGCTGAGTTGGGAAGC
TGCTTCATTTGCATTTAGCATCCAGTGCCAGTCTCTGGTAAACTTGGGAAACAAATAGA
AACTCCGAGATTGTTAATCAGTATACGTGAGTTTACTTGCAAAGAAAAAAGAAGTATGG
AGCCCATATTGATAAATGCTCAAGTCCAGATGTGGAGTGCAAAGGCAGGAATGTCCAAG
TCAAGAAATGCACTCATTGAAACATGTGTAGGAAAACGAGAAGTTAAACTTATTCTCTA
TTTCAGCACTGGAAAGATTAAGACTTTGCAACTACACGATAATATTAAAAGTGTGGTCC
TTCAAACCTATGGCGAAGACCAGAATTACCTACATTTGACTTTTAAAAATAATGATTTC
TTGTTTGTTGAGAAACTCACCACCACAGATGCCAGAAGACTGAAGAGATTTCTAGACAA
AACCTCTCAAGGTAGTATTCGGCCAGCCAGAAGTGATGAGAGATGTGGTGAGCCTAGCA
CAAGTGCACAGGAGTTGAATGGCTCTGGAAGTTCATGTGAAACAAATAGTGAGTGCTTT
GAATCACCCAAAGAAAGTGAAATGTGCATGTTTCGTGAGTTGTCTTTGCTTCCATCCTC
ATCAACCTTTCTTCACAATGTAGGATTATTAGAAAACCAATTCATAAAGAGGAAAAGAT
TTTTCTCTGATTTAGCAAAAAATGAAAAACAGAGCAACCTGAAGGACAGTATCAGGGAC
TTTGAGGCAAATTTAGTGGTGTGTATCTCTAATGAAAAGGGAAAAGAAAGGAATGTAAG
AGAAGTAGACATCAGTAAGCCAGGGTTTGGATTTCCATTTGAGACCAACTATCCTGAAG
ATAGTGGTGTGGATGTTCGTGATCTTAATGATCTCATTACAAAATTATTTTCTCCAGTT
CTGTTGGAAACACACTGTATTGAGAACGGCCTAGAGTGGCATGAATATATGAAGACATA
CTTGCTTTACCCAGAGAAATTGTGGCAAGGCCTGCCTAATGTGGGAAACACCTGCTATA
TAAATGTTGTATTACAGTCTCTATGCTCAATACCACTGTTTATTAATGATTTATTCAAC
CAGGGTTTCCCATGGATTAAAGCTCCCAAAGATGATTTTAACATGCTCTTGATGCAACT
GCTTGTTTTGAAAGATATTTACAACGCAAGATTTAGACAGAAGTTACTTATAGGTATTA
CAAAAGCCCTCCCCATATTTGGAGAGATATTTGCTGTTGACAGGCAGAATGATGCTCAT
GAGTTTTTAAGTCTCTGTTTAGTTCAGTTGAAGGAGACTTTCCAAAGAGTAACCATGAT
GTGGCAGTCTGAAAATGATTCGGGGGATTTTTACTTACTTAAAGACATTTTTGCTGATT

Figure 21b

ATGCTACTATCAACAAAATGCCCGTTTGTCCTGTTACCAATAATTTTGAATTTGAGTTG
CTAAGCTCCATTTTTTGTAAAGCTTGTGGCCTGACTCTTTTTAAGGGAGAACCAAGTAG
ATACCTTTCTATCAACATTCCCCAAGGAGGGAAAGACATGTCCATCCAGTCCACTTTAG
ATCTTTTCTTTAGTGCAGAGGAGCTTGAGCATAGGTGTGAAAAGTGTTTGTACAACAAA
TCTGTTTCATTTCACAGGTTTGGCCGGCTACCCAGGGTAATTATTGTTCATCTGAAACG
CTATCACTTTAATGAGTCATGGGTAATGAAGAAGGATGAGCGGCCCATCCTTGTTTCCA
AATACTTAAGGCTGTCTTGTCACTGTAGCAAAAGCACAAAACCGCCCCCACCCCTTCGC
CCAGGTGAACATGTTAAGAATCTTGACTTATTAAAACCCCTTGAAGTGTTGGGTTCCGA
AATACTCAAATTGCCTTTTAATTCAGTGAGGACCTCTAGATCCAAGGGTTTCGAAACTA
TAAACATCACATCAAACAGGGAGTCAGAAGCACAAAGTGGGAAAAGAGTCTCTGAAGTG
TTGAGTGGAAAAGTGCAGCAGGAAAATTCAGGGAAAGGTGACACAGCACATATAGTTGG
GTCAGAACTTACAAAGGAGACTGAGAAACTCAAGAAACATGAGGAAGAGCATAGACCCA
GTGATTTAGATTCTGGTAGTATCAGGGAGGCCCAAAAGTACCAACAGGCTGAGAAATGT
AACGAAGGGAGAAGTGATAAGCAGATTTCCCTAGAGGCACTTACTCAAAGCCGTCCAAA
ACCAATCTCCCAGGAACAGACAGAAAACCTTGGGAAAACTACACTGTCACATACCCAGG
ATAGTAGTCAGAGTTCACAGAGCTCATCAGATTCCAGTAAGAGCTCCCGATGCAGTGAT
GATCTCGATAAGAAGGCAAAGCCTACACGCAAGGTGGATCCAACAAAGTTTAATAAAAA
AGAAGATAATGTTTACAGGCTTGTTAATATTATCAACCATATTGGGAACAGTCCCAATG
GAGGCCACTACATCAATGATGCCTTTGACTTCAAGAGGCAGAGTTGGTTCACTTATAGT
GATCTACATGTAACAAGAACCCAAGAGGACTTTGTATATAGGGGTCGGAGTTCTACTGG
GTATGTCTTCTTTTACATGCATAATGATATATTTGAAGAGCTCTTGGCAAAGGAAACTC
AGTCTACCAGCACATCCAAGGGTTAGTAAGAGGAGTGTATGCTTCACAGTACATGTCTA
TCCAAATGCCTCACTTATCTAAATTGGATAGAGAAGGACAGATAATTAGCCCAGGACCA
ACAGCTCAACGAACATTTATAGAGAAACGTTTGTTCCAACCCTGACCACATCAGTCTTA
TAATTACAGCTCATGCTAATGAGTGTTCTCTTATACAAGTTTGGAACTGTAACTTTTGT
ATAGTATTTTGTCATAAATTTTATTATTGACAGTAAGGTTTTTCAGTATTTTGGTGGAA
GTTATATAATCCAAAGTTGCCTTTATACCGATTAAAATGACTTATTTTGCTTCCAGTAA
AAGGTATGTTTTCTCTCATTTCTGCTTTCTTTCTTGCATGGCAGCATAATAAGTTCTAA
TGAAAAAGCTTTTATATATCAGAAGGAAAACCACACATGCCCAGACACAGCACAGTTCA
GACGAGTCTATCCAGCGCTGTTACCCCAGCCTGCCGCTCTCTTGCTCTTTCTACATTTG
GAATGGTTCGGTGTCATCCTCCCCTCCTGGCTTTCTCACAGTGGATGCCAATTAATGGT
GATGCTTAAGTGAAGAGAGAAGAGAACATTTTATGGCTGCACATGTTGGAAAAAATACA
AAAATGGGGAGAGGGCTGCATTTAGCTTTTGTTGATTTTTAGGAGTTTTCATTAACACT
GAACAATGTTCTTACTGTTCTCTGATTTAGGCCTTGGTTTTATAAACTGTTTTCAAAAT
AGTTTGATTTTGTTAAGTCTGTTTTCCAGTGTCTGTCTTTAGTTGTCTTGTCTTTAATG
GGGTTATTTTCTTATTAGGAAAAAAACAATTTCCACTTCTAGAATAAACGTTGAAGGAG
CTCTGCATGTGCTCGGGACCTACTGTGTGCTCCTTTCTCCAGAATTCTCTGTTTGGAT
GGTTGACACCGT

Figure 22a

SEQ ID NO.:22 Spg25 encoded protein sequence

MEPILINAQVQMWSAKAGMSKSRNALIETCVGKREVKLILYFSTGKIKTLQLHDNIKSV
VLQTYGEDQNYLHLTFKNNDFLFVEKLTTTDARRLKRFLDKTSQGSIRPARSDERCGEP
STSAQELNGSGSSCETNSECFESPKESEMCMFRELSLLPSSSTFLHNVGLLENQFIKRK
RFFSDLAKNEKQSNLKDSIRDFEANLVVCISNEKGKERNVREVDISKPGFGFPFETNYP
EDSGVDVRDLNDLITKLFSPVLLETHCIENGLEWHEYMKTYLLYPEKLWQGLPNVGNTC
YINVVLQSLCSIPLFINDLFNQGFPWIKAPKDDFNMLLMQLLVLKDIYNARFRQKLLIG
ITKALPIFGEIFAVDRQNDAHEFLSLCLVQLKETFQRVTMMWQSENDSGDFYLLKDIFA
DYATINKMPVCPVTNNFEFELLSSIFCKACGLTLFKGEPSRYLSINIPQGGKDMSIQST

Figure 22b

LDLFFSAEELEHRCEKCLYNKSVSFHRFGRLPRVIIVHLKRYHFNESWVMKKDERPILV
SKYLRLSCHCSKSTKPPPPLRPGEHVKNLDLLKPLEVLGSEILKLPFNSVRTSRSKGFE
TINITSNRESEAQSGKRVSEVLSGKVQQENSGKGDTAHIVGSELTKETEKLKKHEEEHR
PSDLDSGSIREAQKYQQAEKCNEGRSDKQISLEALTQSRPKPISQEQTENLGKTTLSHT
QDSSQSSQSSSDSSKSSRCSDDLDKKAKPTRKVDPTKFNKKEDNVYRLVNIINHIGNSP
NGGHYINDAFDFKRQSWFTYSDLHVTRTQEDFVYRGRSSTGYVFFYMHNDIFEELLAKE
TQSTSTSKG

Figure 23

SEQ ID NO.:23 Spg27 cDNA sequence
TTCCCTCAGGCGGTGCGTAAAAAAATATTTCTTGGAAGATGGCCACTATGCAGTTGCAG
AGGACAGCTTCCCTGAGTGCATTGGTATTTCCCAATAAGATATCAACTGAGCATCAATC
TTTGATGTTTGTGAAGAGGCTCCTAGCTGTTTCAGTATCTTGCATCACCTATTTGAGAG
GAATATTTCCAGAACGTGCTTATGGGACAAGATATCTGGATGATCTCTGTGTCAAAATT
CTGAAAGAAGATAAAAATTGTCCAGGTTCTTCACAGCTAGTGAAGTGGATGCTTGGATG
CTATGATGCTTTACAGAAGAAATATCTAAGGATGATCATTCTAGCTGTATACACCAATC
CAGGAGATCCTCAGACAATTTCAGAATGTTACCAGTTTAAATTCAAGT

Figure 24

SEQ ID NO.:24 Spg27 encoded protein sequence
MATMQLQRTASLSALVFPNKISTEHQSLMFVKRLLAVSVSCITYLRGIFPERAYGTRYL
DDLCVKILKEDKNCPGSSQLVKWMLGCYDALQKKYLRMIILAVYTNPGDPQTISECYQF
KFK

Figure 25a

SEQ ID NO.:25 Spg33 cDNA sequence
ttgaccctttataaggccttgttggtcctccctggtgttcagtgcttagcgaggagggc
ctggctctggagtccattagctggcacctgggcgctcagtcagggagctccccatatat
tggagcaagtgtgaagctgaagaagtttctggaagctcaagcctgtctacttcttcaga
gagcctctgtggttctgttgacctgacctcctcagtccatcgagcaagtctgaatctgt
gtgtccgcttagctgcagacagacttcttgaccATGTGTCCCCCAGTCAGCGTTCGCCA
TGGGGCCAGGGGCATGTCCTGCCTCTATGAGGCATGGCTGTACCATCTTGTCCATGGGG
AACAGACGAAGATCTGCTTTGCTTGCTTCAAGGCAGCTTTCCTATTGAATAAACTCTAC
CTGGAGATGGGAGACTGGCAAGAGGAGGAAGAGGAAGAGGAAGAGGAAGATGCTGATCT
CCTGGAATACTTGTCAGAGTCAGAGTCAGAGTCTGAGCAGGAGCCAGGGCCTGAGCAGG
ATGCATGGCGGGGATTGGGGTCCCTTTATGTGCCACAGAGTGTCTCTGAAGGGTCTGGG
GTCCTGCTGCCAACCCCTGTGTGGACACAGGGCATACTATTCTCCATTTTTGTGCCCAC
TGAGCTCTTTCCTCAGGAAGCTGTACCCCTGGATCTGGGTCCTGAGGATGCTGAGTGGA
CCCAGGCCCTTCCCTGGAGACTTGATGGGCTTTTTCCCTGCTCGCACCAGCTCATCCCT
CCTCTGACTTGGTGGGATATTTTTGATGTGATGCCATCTCCTGGGCAACCTGTGTTGTT
GGAGTTGAGATGCCACTGGCCCTTGGACCAGACAGTAGCACAATCCTGGTTGCAAGACC
AGAAGTTTGTCCTCCTGTTGGATAGCGTCCAATCTAGGTGCCACCTGCTGTCAATGCGT
GTCCGCTGGGTCGTAAGGACTCAGGTCCAGCACTGGCAGGTGTTGCTGGACCCTGGTGA
GATGTGGGTGGCCCATTTTCGGAAAGAAGTTGGGCAGCACGGCCTGTACCATCAGAGCC
TGAATCCCTGGAGGCTGAGCATCCTGACAGCTTCAGAATTAGGGATGGAGTTATTGCCT
GCCACCTGCTACCTGTGGAATAAAGGCTTCTGGGTAGGTTCCTTCTTGCCCTGGCACAT
TAACATGCCAGAGACCTGGAGCTGGGAGCCAGGAGAGAGGCTGTTTATCACAGATGCTA
CTATTTGTGGTACTGACTACCACCTTGCTCAGTCTTTCCTTGATTCCCACCCCACCCCC
CACCCCCTCCTGACCCTTACTCCCTGAtgcacattcctgagacactaaagctcagacat

Figure 25b

tccccagggccctggggactgtgaagagcaagaggttgcctgttctgagcagctcaggg
gaacagttggtccaggacttgaggggcatcttgaacatcctgtgagcttatgaacctc
agagggaagtctggcatgttcgtgtcagtgttcagtgtttggtaggtgaggcctagctg
tatgtttagctgtatggagtgttgtgtggtgggtgttatggggctccggtcacagatc
tacgtatgtatggactctgaggcactagttgaccttactgtcataggggtcatatgctt
actgtcttagggtcaagatacctgattttagggttcactgtttttgttgtttactttg
ttcgttactcgtgctccttttgagggcttttgttgaataaagttggtgttttaaaaa

Figure 26

SEQ ID NO.:26 Spg33 encoded protein sequence

MCPPVSVRHGARGMSCLYEAWLYHLVHGEQTKICFACFKAAFLLNKLYLEMGDWQEEEE
EEEEEDADLLEYLSESESESEQEPGPEQDAWRGLGSLYVPQSVSEGSGVLLPTPVWTQG
ILFSIFVPTELFPQEAVPLDLGPEDAEWTQALPWRLDGLFPCSHQLIPPLTWWDIFDVM
PSPGQPVLLELRCHWPLDQTVAQSWLQDQKFVLLLDSVQSRCHLLSMRVRWVVRTQVQH
WQVLLDPGEMWVAHFRKEVGQHGLYHQSLNPWRLSILTASELGMELLPATCYLWNKGFW
VGSFLPWHINMPETWSWEPGERLFITDATICGTDYHLAQSFLDSHPTPHPLLTLTP:

Figure 27

SEQ ID NO.:27 Spg34 cDNA sequence

ggcacgagctgcagcctagctgttgagctgctctagcgatcatctgttctgaggtactt
tgggactgtgggactgtgttctttgctcctgccctgcccctgtgagcgggtggggaatc
gctgagcctgtggttgtacagctcaagtgcctgccATGGCCGAAGCGCCCTCTCGAATG
CAGCAGAACTATGACTGGCAGTGCGAGGATGCTATCAACACCCACATCCAGCTGTGCCT
CTATGCCTCCTACGAGTACATGTCGATGGCAGTCTACTTTGACCGTGATGACGTGGCCC
AGGAGAACTTCAAGCGTTTCTTCTTGACCAAGTCACACAACTGCCAGACCAGTGCAGAG
ATGTTCATGCACCTGCAGAATAAGCGTGGAGGCTGCATCTCCCTTCAGGACATCGCGAG
ACCAGAACGTGACAGCTGGCACGGGGGATTTCAAGCCATGGAATGTGCCTTCCACATGG
AGATGCTGATCAACCAGAGCCTGCTCAACATGCACGAAGTGGCCAAGGAGAAAGGCGAC
CCCCACCTCTGCCATTTCCTGGAGCAAAACTGCCTAGATCAGCAGGTCGACATTTTGAA
GGAGATGAGCGGCTACCTGACCAACCTGCGCCAGATGGGGGCCGTAGAGCACAACTTGG
CTGAGTACCTCTTTGACAAGCTCAGCCTGTCCTAAagcttcaagtggactgaactggga
tgtctccactgtcgtggggtctttctctggtcattacacctaatgttcatgttggtttt
gaagcaaagttcactcattttcggtttctgatggactgttgctttaaataaattttgtc
tgtttgtttgcagcaaaattgaaaaaaaaa

Figure 28

SEQ ID NO.:28 Spg34 encoded protein

MAEAPSRMQQNYDWQCEDAINTHIQLCLYASYEYMSMAVYFDRDDVAQENFKRFFLTKS
HNCQTSAEMFMHLQNKRGGCISLQDIARPERDSWHGGFQAMECAFHMEMLINQSLLNMH
EVAKEKGDPHLCHFLEQNCLDQQVDILKEMSGYLTNLRQMGAVEHNLAEYLFDKLSLS

Figure 29a

SEQ ID NO.:29 Spg39 cDNA sequence

gtgcggtcttgtgttcctgtcacttctgtcgccctttggtttcaggactgctcatctca
cagggccagccaagcccctagagcactcagccatcATGAATTGCGAGGATGTCACCACC
GGGTTCCGCCATGCCAGGGTGTTAATGTTCATCAACGAACAAATGGCCAAGCACTCCAG
AGGCCCGGAGTTCTACCTCGAGAACCTGACCCTGTCCTGGGAGGAGGTGGAGGAAAAGC
TCAATGTCCTCCTGGACGGTACCGAGGTGCCTCGGGATGTTCAGGAAGCCTGTGCCTGG
AGCAGCCTGGCCCTGGGGGTTCGCTTCGCTTTCAGGCAGGGCCAGTTGCAGGGGCGCAG
AGTGCAGTGGCTGCACGACTTCGCCAGCCTGCACAGGTCAGCGGCGCATGCCCTGGCAT
TGGACCTGAAGAAGCTCACCGACCAGCACGAGATAGAACGCAAGGAGGCGGCCTACCAG

Figure 29b

CTTCTTTTGGCCCACACTAAACTCGCAGAGGTGCAGAGAGAGCGAGACCTGATGAGACT
GAAGCTACTACACGCAAGATTTGCCACCCATATGAGAGTTGTGCGAGACTACAGAGGAT
GCCAGCACCAGGTACAAGCAAGAATGTCTACAATTATACAGCCTCTTAACAGAAATCGT
CCCTAGtccccagaggcagaaccagagacagatctgaacaggaaacttctgccaactg
ctccaagtcctcaggtagaaggaaggcgaaggactgtatctgatccggactgagacaca
actggaagagtcctatctcccagagactgtgaacctggagaatacgaagctgttgtggc
ccatgggacacctgtagcatcagaaatgtgacttcgggttgtctgttattggtgaggat
acagctgcctccaggattgcaggccagatccctgtcctgcaatttttgaacactcttt
gggcttgcttatctcccctctactgcagggtttcctaacctcattgcacttgacatctgg
attcggatagttctttgctgtggggtaggaagtcctgtgtactgtaggcagtgcggcaa
aaccagagttgggaacaactaagttggaaattgaaggccttagcagtgtggacaaaaac
tcaaatagccaaggtcacagaggctgaagctggcaaaagaaaaaaacaaaaaccacagt
tctttaagactggtgtttactttggatcttcaagaagttagggtggtggcagagtagaa
accaaacggtcaggactgaggggaacctctaccctctacaacagtagtttcaaccttta
atgtttcatctcatgtggtggtgacccccaaccataaaattaccttcactgactggtac
ttcatatcatactatgatgaattataatgtaaatacctgtgtctcccaaaggtcttagg
tgacccctgtgaaaggcttgtttgacctccataggggtcacagcccacaggctgagaac
tgcagctttacaagaactctaggctgcaaagggaaggagtacaggaagcgccatggatc
ctacagtgttagtttgtcagctagccaacatgcttggcaaactagattggataaaatct
cgaacatggcgtttaaactctgataaaggcagtaagagttaaggttaggtactttttga
gcaatttcctcaaagataaaacattgcaacctgcaggaaagctcatgaagactcagtag
tagaaacgagccattaaaggagaatgctttaaatgaaagaaacaagaaaaaagatggtc
ttatatagtggatgggaggactagccaatagtattagaaggaaaacaacacgatgaaag
ggaccattgttttgtgtaagataaaaacacttaaagttcttaggtatgtgcatgtatgc
tctatgtaaatatgttacaaatttatgtctataaaatctgtattttcagtaagcattga
aaagatatggaaaagatatttagtgaacaggcagggaacagaaggcagtgtggtatggg
gggtatagaacagaatacagccaagtttgaataaaggtttttctttatgtacttctgt
gttttgaaagtaataaggtgtttacaaaaataaaagttatttacccacttgaaaaa

SEQ ID NO.:30 Spg39 encoded protein sequence Figure 30

MNCEDVTTGFRHARVLMFINEQMAKESRGPEFYLENLTLSWEEVEEKLNVLLDGTEVPR
DVQEACAWSSLALGVRFAFRQGQLQGRRVQWLHDFASLHRSAAHALALDLKKLTDQHEI
ERKEAAYQLLLAHTKLAEVQRERDLMRLKLLHARFATHMRVVRDYRGCQHQVQARMSTI
IQPLNRNRP.

Figure 31a

SEQ ID NO.:31 Spg46 cDNA sequence

gggctggagggctgagggtggagcgcctggcATGTGGGGCCAGCGGCTCTTTGCTGGGA
CGGCTGTGGCGCANAGTGTAAGTTTTCCAGGACTTGTCCAAATGGATGAAGATACACAT
TACAATAAAGTTGAAGATGTTGTTGGAAGTCATGTAGAAGATGCAGTAACATTTTGGGC
CCAGAATGTCAGTAAAAATAAGGATATTATGAAGATTGGTTGTTCACTCTCAGAAGTTT
GTCCTCTTGCTAATTCAGTTTTTGGCAATCTTGATCCTAAGAAGATTTATGGTGGATTG
TTTTCTGAAGATAAGTGCTGGTACAGATGCAAAGTGCTAAAAACTATCAGCGATGATNA
GTGCCTGGTGAGGTACATTGACTATGGAAATACTGAAATTCTAAACCGATCTGATATAG
TAGAAATTCCTCCGGAGCTACAATTTTCTAGTATTGCCAAGAAGTATAGACTTTGGGGA
CTACAGATTCCTTCTGGCCAAGAAGTTACCCAGTTTGATCAGGGTAGAACATTTTTGGG
GAGTTTGATTTTTGAAAAAGAAATTAAAATGAGAATAAAAGCAACATATCAAGATGGAA
CAGTTATTGCTCAGGCTGAGTATGGCACTGTCGATATAGGGGAAGAAGTGGCAAAGAAA
GGATTTGCAGAAAAGTGCAGACTGACCTCAGGCATTGATGCCTGTGAGGCAAAGAAACC

Figure 31b

TGATCCTAATCAGCTTGCTCTCAGGAGTCTCAAGAACCCTATCCCCCTGTGGGGCGCA
GATCAAACCAGTCAACCTTCAGCAGGCCAAAGGGGCATTTTAACGGGAGGCTGACTCTT
GATGTGAAGTATGAGACCAGTGCAGGCAATCACGTGACATTTCCAAAGGAAAGTTTGGC
TGCTGGTGACTTTAATTTAGGGTCTAATGTCAGCTTGGCAAAAATTAAACAGGACCAGA
AACTTATTGAAGAGAATGAAAAGCTTAAAACAGAGAAAGAGGTTCTTCTAGAAAATTAC
AAAGCATTAGAATTAAAAGTTGAGCAGACTGCCCAGGAGCTGCAGCAAGAGAAAACAGC
TACCATGGATCTGACTAAGCATTTAGAAAGCACTCTGAAGACGTGTGTAGGAACCAGGC
TGAAGAATTTGGCAGCTAAAGTAGAACTATTGAAAGAAATTAGGCATATTAACATCAGT
ATTCGCTTTGGAAATGACCTTTCAGATGCTATGCAAGTGTTGGATGAAGGGTCCTTTAC
TACTCTAGCATCTTTGAATGAGTTAGAGAAAATTTGGGCTGAATATAATGTTGCTCAGG
AGAAGATCCAAACTTGTCTTAATGAGAATGAAGGTAATATTTTGATTGCTGAAAGAAAT
GAAGTACAACAGAAGCTGTTCGTGGCTGTAGATGTTTTTATTCTGGAAGTAGATGACTT
ACCACTTGATAAACGCTTAAAAACATTGCAGGACTTAGCAACTTCTTTAGAATCAGTGT
ATGGAAAGGCCAAAGAAGGAACTAATAACTCTGAAGAAACACTTAGAAAGTTTTTTGAC
TGGCAGTGTACCAAAAGAGAAGAGTTCGCCAGTATTAGGAGTGAAACAGAGGCATCTCT
GCAGCACCTTGTGGCATGGTTCCAGAGCAGCCAGAAGGTTTTTGATCTGTCCTTGGATG
AACCATTGACTTCAGAAGACCTGATTGGTAATATTGACGAAATTCTAGAGAAGACTGAG
TCATGTGTCTGCAAAGAGCTAGAGCTGTCTCTCATTGAGCAAGGTGTCATAGACAAGGA
GATTATTTTAATTACATACAGTCAAGTGCTGCAAAAGATCCATTCTGAGGAAAAGTTCA
TTGCCACCTTGCTGTCCAAGTATAAGGACAGTGTTGAGTTTAAAAAGCAGATGATTGAC
TGTTTAAATAAGAACCCCAATGTGGATTACTTGCTTTCTATTAAGAAGACATTGAAAGG
CTTAAAAGCACAACTGAGATGGAAATTGGTTGAGAAGAGTAATTTGGAAGAATCTGATG
ACCATGATGGAACTGAAATTGAGAAAATAAAGCAAGAAATAACTCAATTGCGAAATAGT
GTTTTCCAGGAAATTTATCATGAGAGGGAGGAATATGAGAAGCTGAATAGCTTGACCCA
GAAATGGTTCCCTGAGCTGCCTCTGCTGTATCCTGAAATAGGATTGCTTAAATATATGA
ATTCTGGTGGTCTTCTTACTATGAGCTTAGAGCGGGACCTTCTTGACACTGAGCCCATG
AAGGAACTTAGCAGCAAGCGTCCTCTGGTGTGCTCCGAGGTTAATGGGCAGCCAGTTCT
CTTAAAGGGCTATTCCGTGGATGTTGACACAGAAGGCAGGGTGATTCAGAGAGCAGCCT
CTTACCATAGAGCTTGTGGATATGCTAAAGAAGAGTCTGGGTTACTGCCATTAATATTC
TTGTTTTTGTGTAAGTCTGATCCTGTTGCCTATCTGATGGTCCCATATTATCCTAAGGC
AAACCTGAGTGCAGTTCAAGCCAGTATGCCTTTAACTTCAGAAGAAGCTTTAAAAGTCA
TGAAAGGTGTTGCCCGAGGACTGCATACATTGCATAGTGCTAACATAATTCATGGATCA
CTTCATCAGAACAATGTATTTGCCTTAAATCGTGAACAAGGGATTGTTGGAGATTATGA
CTTCACCAAATCTGAGAGCCAGCGAGCTTCAGTCAACGCGATGGTTGGTGGATTGAGTT
TGCTCTCACCTGAATTGAAAACTGGAAAACCTCCTTCTGCAAGTTCAGACTTATATGCT
TATGGTTGCCTTTTCTTATGGCTTTCTGTTCAAAATCAAGAGTTTGAGACAAATGAAGA
TGGAATTCCAAAAGTAGATCAGTTTCATTTGGATGATAATGTCAAGTCCCTCCTTTGTA
GCTTGATATATTTTAGAAGTTCAATGACTGCTGAGCAGGTTTTGAATGCTGAATGTTTC
TTGCTTCCAAAGGGGAAATCAGTTCCAATCCCAGAAAAAGAGATTGAATGTACTCAGCA
TAGCAGAGAAGATGAATCAAAGATGGAGAGTCTGGATAGATATAGTGAAAAGACAAGAA
ATGGTGAAGCCAACCCTTGActaacaaattaatccctttattgttgctgtatatgtccct
tttaaaactttgttctgtttgcttagtagacaaaaatgttctggaactagttggattg
catctttggatttgggttgtaaaaaataaaagaaatgttttgattacacctaaaaa

Figure 32a

SEQ ID NO.:32 Spg46 encoded protein sequence
MWGQRLFAGTAVAXSVSFPGLVQMDEDTHYNKVEDVVGSHVEDAVTFWAQNVSKNKDIM
KIGCSLSEVCPLANSVFGNLDPKKIYGGLFSEDKCWYRCKVLKTISDDXCLVRYIDYGN
TEILNRSDIVEIPPELQFSSIAKKYRLWGLQIPSGQEVTQFD

Figure 32b

QGRTFLGSLIFEKEIKMRIKATYQDGTVIAQAEYGTVDIGEEVAKKGFAEKCRLTSGID
ACEAKKPDPNQLALRSLKNPIPLWGRRSNQSTFSRPKGHFNGRLTLDVKYETSAGNHVT
FPKESLAAGDFNLGSNVSLAKIKQDQKLIEENEKLKTEKEVLLENYKALELKVEQTAQE
LQQEKTATMDLTKHLESTLKTCVGTRLKNLAAKVELLKEIRHINISIRFGNDLSDAMQV
LDEGSFTTLASLNELEKIWAEYNVAQEKIQTCLNENEGNILIAERNEVQQKLFVAVDVF
ILEVDDLPLDKRLKTLQDLATSLESVYGKAKEGTNNSEETLRKFFDWQCTKREEFASIR
SETEASLQHLVAWFQSSQKVFDLSLDEPLTSEDLIGNIDEILEKTESCVCKELELSLIE
QGVIDKEIILITYSQVLQKIHSEEKFIATLLSKYKDSVEFKKQMIDCLNKNPNVDYLLS
IKKTLKGLKAQLRWKLVEKSNLEESDDHDGTEIEKIKQEITQLRNSVFQEIYHEREEYE
KLNSLTQKWFPELPLLYPEIGLLKYMNSGGLLTMSLERDLLDTEPMKELSSKRPLVCSE
VNGQPVLLKGYSVDVDTEGRVIQRAASYHRACGYAKEESGLLPLIFLFLCKSDPVAYLM
VPYYPKANLSAVQASMPLTSEEALKVMKGVARGLHTLHSANIIHGSLHQNNVFALNREQ
GIVGDYDFTKSESQRASVNAMVGGLSLLSPELKTGKPPSASSDLYAYGCLFLWLSVQNQ
EFETNEDGIPKVDQFHLDDNVKSLLCSLIYFRSSMTAEQVLNAECFLLPKGKSVPIPEK
EIECTQHSREDESKMESLDRYSEKTRNGEANP.

Figure 33a

SEQ ID NO.:33 Spg58 cDNA sequence

caaagtctgATGGAATCTGAAAAAACAAAGATGGAGAGTGAAAGTTTGTGGATGATCTC
TGATTCTGAGAGTTATTCAGTGGACTCACACACAGAAAAAGGTAGAGCATCAGTATCTA
AAATAAATCTGATACAAATTGATGAAACAGAAAAACCAAGAACTAAGAGATACTTGATG
GAGTCTGATTCTGAATCAAGTAATACAGACTCAGATTCAGAAGGATGTGAGCTAGCCTC
AGCAGCTGTGAAATACTTCATAGCTACAAAGACATTTCAGCAGAGCAGTGCTAGCAGCC
AGTTCCCAAAGGATTCATGGTCTGCAAGTAGAACAATAAACTCAGACTCTGAAAGCCCT
GTGATGTCCTCTGATTCTATGAAATACATGAAGAAAGCTGAAACATGCAAGAGTACCTG
TAATTTGGAAAGACTCAAGGCGGCTCACAAGTCTGAGTCTCTACAGGACTGGTTAGATG
CTAAAAGAAAACAATTAGATTCTGATAATGCTGGATACTGGGATAGCTCTGGAAAATAT
CAGTTTAGTTCTATAGTACCTCAAGAGAGCGTTGGAAAACGTCAGGGTGACCTTCAAAC
GTTTCAGCATAGCACTGAAAAAAAGGAAGTAGGATCCAGTTCTGATAAACATCAGGCAC
AATTTGGAAATGAAAGAGATCAAAGTGATCCTAAAAGTAAAAGATACCTCATAAAGACA
GAGACGGATTAGACAATGAGGGGTTTCAAATGGATGAGGAAAGAGAAGGATGTCTTGT
GGAATCTGACTTTCGTGATTCAGAACGTGAGGCACACCTGCTAGAAGCCCACCGGCTTG
GTGCTCGTAAAAAGGAGAATCGTCCTCCAGGGTTTTGGAGACCCATTATCCTGCCTCCT
AAGCTTGCCCAGGATAAGAAAACTGAAGAACAAAAGTCTGTACAGCAAAAGGATAACAG
AGTTTCTAGAATTCAGCTAACAAGATACAAGAGTGAAGACAAAAATGTGAGATTCGAAG
AGGCATCTTCAAGTCTCAGTGACAAGCCACTCTCGCAAGAAAAGTTAAAGAAAAAGCAC
AGCTATAGCTTTTCTCCAGACTCTCCCACATTCACAGATGAAAAGCATCACAGAAAAGC
TAGCCTGAAAATATCTGGCTATAAGCGCCAGTGCAAGGAATATAGATATCCCCATAGTT
GTGAAAGTTTGAAGTATCAAATCAGTCCCATTCCCCTAAGTTCTGAGACTTGCACCTCT
AATGTATCATCATTTGTTGACAGCCCAACTTCTAAAAGTCCTAAGTCTGTCACAAGAAA
GAAGTCTCGAAGAAGTATTACATATTCTCCAGAACAGGGAAGTCAAAAATGTACTAGAT
GTTTTATGGAAATCAGTAACTCATCTTATCATAAATGCCTCATAAATTCTGATGATTCT
GACTCAGACTCTCCATTACATGGCCAGATTTCCTCACATTCTAAATATTCTCTGCGCTC
TAAAACTATCAGACACTTCAAGACTTCTCGAAATCGCCCTTTATCTCAATCCCTGGATC
CTCAGCATTCTGTGGTCAGCCGCTGTTCTCTGCACAGGGAAGATTCTAAACATTCTATA
GATTCCACCTCTTATTTACATTGTGAAAGTTGTGCATCTCTTCAAAACCTTAAGGGCTC
TTCTGTTACACACACCATTTCTAAGACCACTAAGAAAATCATGGGCCAACATAGTACCC
ATGGCCACATATCAGGACCTGTAAGATTGTCTCAAAGTGAAAGCAAGTTCAACCTTACT
GCTCAACCTCAAAATGAGGATACTCCTGATGTCAGTGATAGAAATATCAAAGCTGAGGC
TAATGTTGAAGATAAACTTCTTTACAAAGATGATACAGACCATGAAGATGAGACAAATA

Figure 33b

CTGAAGATGAAACGGATGGTGAAGATGAAACAGACACTGAAGATGAAGATGAAGATGAT
ACCAAAGATAAAAAAGATCCTAAAGACAAATCTGACCCTGATGGCAGTGATCCCAAAGA
TGGCAACTCTGAAAATAATACTGATAGCAACAATGGGTCTCAACCTAGTGGTTCTTCTG
GACCTACAGGTGGACCTGATTCCAGCAATGATGGTGACTCTAAAAATGTAACTGATCAC
AAGAGTGAATCTGACCCTACCATTGATAACGCTACCAACAGTGATGTTAACTTGAAATA
TAGCACTGATGAGACATGTACCAACAATTTAGACAATGCTTCAGATCTGGCAGAATATT
TCAATCATCACAATAATGCTGACTTCAAGGGTCGCACAAACCCAGCCTCTGGAAACAAA
ACTAGAACCATACTGGACTATATTTCTGGTTCCAACAATGAGGACACTGGCCCTAGAAA
TACGATGATAAAAGAAAATATTGCTTATTCTGAGAATATTAGATTGCTTTCCAACAGTT
ATCAAAATAATGTCATTAAAAATGGGAGTGAACCAAGCAGCAACCCAAGCCCCCAAAAC
AGCTATGGGCTCCCAAAAGACCTTGACTCTAACTCTAATATCAATCCCAGTAATGCTAC
TAACAATACTGTTAACCCTAACTATGGTGCAAAATCCACGAGCACTGCTATTTACAAAA
AGACAGCTGCCCTAAACTATTATTCAGATATTAATGATGTCACAGGGTTTACATATGAA
GTAAGGTCAAGTTTTGTAGTCAACTCAAACTATTTTGACAGAAAGAAATATGCTGGTAG
ACTCAGCTTTGCACTTCACACTATCAATGCCATTGATACAAATAATGTTATCACCTGTA
CTAGTGCTGTTAGGTCTCAGTTTGCTTCTGAAAAAACCTCTGTCCTAGACACTAAACAT
TCCCCTAGATTTAGTCGTTTCAGGAGTTTCAATGTTATCATCAGCCCAAATTATAATAC
TAAAAATAGTCAGAATGCTAATAAATCCAGTATCAGCAATATTTACAACCTACCTGCCA
CTGAATTAGAAATAAATATATTATCTGTTCTTAAAATCATTTATGGAAATACCCCAAAT
TTTATTGCTGGAACAAACTATCCTGATTTTTTGATAACCTCGGAATTTTATGAACCCCT
TAAGCTTTGTAGAGCTTATAAAATTTTTGATAACCAAAATATTGATGCTCCATTCCAAG
ACTCTGCTGGATACATGGACTCTGATAATTCTACATATGCCACTGGGTCCATGGTTGCC
CTTGATGCCAAAGAATCTGGCTTTTTAAAATATTTTCCTAGGATCCAGAATACAATTGG
CATCAAGGATCCTTCTTCCCCTTTCAAGGTGTTTTCAAATCAAAATATTCTAGTCCCTA
GTTTCGATGTTATAGTGGAAGCTGAACTGCCAGATATTATGAAGTTTACTATATCATCA
GGTGCTGTGAATCAATTATTTCAGCTCAGACTCCAAACAGGTAGCAGACAAAATGTTGA
CCTTTGAttaatgaaaagaataccttgggatggaaaagacaaaagcacaaccaagaagg
ttctgaggagatgagcaaataacttcaaaagaactacagtgttccctgaacaatgttta
ttttatgtttattcttagatattcaccccattatatgtccatgtttttattgtctattg
tggccacaaatacttcaaagtaccatgtgacaattgccccttccatatgatttacatgt
ggcagagtatggaattaggaaaggacacactgtagtcctttttctagacagcatccaaa
aataaattttactactatgtattcataatatagatgagcttttcaagcaaattcttcct
tgtattattctctgtattttgaagaagagggctttaactttaaaaaaatttaagacaga
taaaattttttttagtattgtggtgacaattctagatttaaaagaacccatactaaatc
tataatttattgttaatcttaattgttgttactgttttgtgagtttggagctcgaaatt
aaaatagttaagactcataaaaaa

Figure 34a

SEQ ID NO.:34 Spg58 encoded protein sequence

MESEKTKMESESLWMISDSESYSVDSHTEKGRASVSKINLIQIDETEKPRTKRYLMESD
SESSNTDSDSEGCELASAAVKYFIATKTFQQSSASSQFPKDSWSASRTINSDSESPVMS
SDSMKYMKKAETCKSTCNLERLKAAHKSESLQDWLDAKRKQLDSDNAGYWDSSGKYQFS
SIVPQESVGKRQGDLQTFQHSTEKKEVGSSSDKHQAQFGNERDQSDPKSKRYLIKTETG
LDNEGFQMDEEREGCLVESDFRDSEREAHLLEAHRLGARKKENRPPGFWRPIILPPKLA
QDKKTEEQKSVQQKDNRVSRIQLTRYKSEDKNVRFEEASSSLSDKPLSQEKLKKKHSYS
FSPDSPTFTDEKHHRKASLKISGYKRQCKEYRYPHSCESLKYQISPIPLSSETCTSNVS
SFVDSPTSKSPKSVTRKKSRRSITYSPEQGSQKCTRCFMEISNSSYHKCLINSDDSDSD
SPLHGQISSHSKYSLRSKTIRHFKTSRNRPLSQSLDPQHSVVSRCSLHREDSKHSIDST
SYLHCESCASLQNLKGSSVTHTISKTTKKIMGQHSTHGHISGPVRLSQSESKFNLTAQP

Figure 34b

QNEDTPDVSDRNIKAEANVEDKLLYKDDTDHEDETNTEDETDGEDETDTEDEDEDDTKD
KKDPKDKSDPDGSDPKDGNSENNTDSNNGSQPSGSSGPTGGPDSSNDGDSKNVTDHKSE
SDPTIDNATNSDVNLKYSTDETCTNNLDNASDLAEYFNHHNNADFKGRTNPASGNKTRT
ILDYISGSNNEDTGPRNTMIKENIAYSENIRLLSNSYQNNVIKNGSEPSSNPSPQNSYG
LPKDLDSNSNINPSNATNNTVNPNYGAKSTSTAIYKKTAALNYYSDINDVTGFTYEVRS
SFVVNSNYFDRKKYAGRLSFALHTINAIDTNNVITCTSAVRSQFASEKTSVLDTKHSPR
FSRFRSFNVIISPNYNTKNSQNANKSSISNIYNLPATELEINILSVLKIIYGNTPNFIA
GTNYPDFLITSEFYEPLKLCRAYKIFDNQNIDAPFQDSAGYMDSDNSTYATGSMVALDA
KESGFLKYFPRIQNTIGIKDPSSPFKVFSNQNILVPSFDVIVEAELPDIMKFTISSGAV
NQLFQLRLQTGSRQNVDL.

Figure 35

SEQ ID NO.:35 Spg59 cDNA sequence

tttttttttttttgtttttgatttttgtttttttaaatgtactttaagagaaaaggag
aagagaatgccagaaaactaagatggttcaattaatccacttccttcagccttatgccc
ttggataggacatcctccatacaccggccATGGTCCCTCGGAAAGCCCACAATTTCTCC
TGCTGCTTCCTTAAATATTTCAGAGCCCCTAGAGTATGCCTCCAACCCCTGCTACCCCA
TCTCCCACAAACCACCTTCCCAGGCCCCAGGGTGGGGACAGGCACCAGAGTGGGCACCT
CAGGAGATTTTCCGAGGTTGTCTTCAGTGCCCGCTACATTGGAAAACTGCCTGTTTCCT
AGTGGCACCAGGAGGGTTGCCTCGACTCCACGTGCATGCTATCCTTTCTGTTTATTTCG
GTTATTCCAAGACCCAAAGACCTTCACACCCACCCACCCTCCGCCGCCTGCCGTCATGA
AGGTTATAGAGTTGAGACCAGCAAGTCTTGGATGTGAGGGCTTTAATTTATCTACCTCA
ATTATCTTTATTTTTGTAGCCAAAAGTCTTCTCTATTTTGCTATTTTTGCGACCACCCA
AGTATTGCCAGGTCTTAAACCTAAGAGTTCTTATACTGGTAAGAAGGCCCCGAAGCTCA
AGAAGTCTTCGTGGTTGGTTCTGTGGGTTTTGTTTTTGTTTTTAATTACATTTTTGTTC
GTGTAAtaattctgaacagctgttgtaacagtgttccaatggtttagtgaggtaggaga
gatttctccagtctctgggtagaaaattctgcctgccgtgttgaatgcccttgccaaat
gaagatggagactctcgcccagtgtttcctctgacttgttgcacctgatttaggatcc
aaaacttgttttgttgttacttctttctttttctctttcttttttttcgccaagtcgtgc
ctttccttctggcattgtaagtgaaccccgtgatcaagtgttcaccggttcacctgttt
acactgtgaagtgggtatcttacggagaacacaccagccttggtttctcacgccccgt
gaatgaatgtgtacgccacagttttacctgctgatactgtaaggtctgaaaataaagtg
aatgttttccctccatg

Figure 36

SEQ ID NO.:36 Spg59 encoded protein sequence

MVPRKAHNFSCCFLKYFRAPRVCLQPLLPHLPQTTFPGPRVGTGTRVGTSGDFPRLSSV
PATLENCLFPSGTRRVASTPRACYPFCLFRLFQDPKTFTPTHPPPPAVMKVIELRPASL
GCEGFNLSTSIIFIFVAKSLLYFAIFATTQVLPGLKPKSSYTGKKAPKLKKSSWLVLWV
LFLFLITFLFV

Figure 37a

SEQ ID NO.:37 Spg64 cDNA sequence

GGCACGAGACTATTTCTTCGTACAGGAGAAGATTCCCGAACTGCGCCGGCGAGGCCTGC
CGGTGGCCCCGCGTGGCAGACGCCATCCCCTACTGCTCGGCCGACTGGGCGCTCTTGAGG
GAGGATGAGAAGGAGAAATACTCAGAAATGGCTCGAGAGTGGAGAGCAGCCCAGGGAAA
GGATTCTGGGCCTTCAGAGAAGCAGAAACTTGTATCTACACCACTGAGGAGGCCAGGCA
TGCTTGTACCAAAACCAAGTATTTCTCCCCCTGATATGTCAAATTTATCTATAAAAAGT
GATCAAGCTCTCCTTGGAGGCATTTTTTATTTTCTGAACATTTTTAGCCATGGTGAGCT

Figure 37b

ACCTCCTCATTGTGAACAGCGCTTCCTCCCTTGTGAAATTGGCTGTGTTAAATACTCCC
TCCAGGAAGGTATTATGGCAGATTTCCACAGTTTTATCCATCCAGGTGAAATTCCACGA
GGATTTCGATTCCATTGCCAGGCTGCAAGTGATTCTAGTCACAAGATTCCTATTTCAAA
CTTTGAATTCGGGCATGACCAAGCAACTGTGTTACAAAACCTCTATAAATTTATACATC
CAAACCCAGGGAACTGGCCACCTATTTACTGCAAGTCTGATGATAGAGCCAGAGTCAAC
TGGTGTTTGAAGCGTATGGAGCGGGCATCAGAAATAAGGCAAGATCTAGAACTTCTCAC
TGTAGAGGACCTTGTAGTTGGGATCTACCAGCAAAAATTCCTCAAGGAGCCCTCTAAGA
CCTGGGTGCGAAGCCTCCTAGATGTGGCCATGTGGGACTATTCTAGCAACACGAGGTGC
AAATGGCATGAAGAAAATGATATTCTCTTCTGTGCTTTAGCTGTTTGCAAGAAAATCGC
GTACTGCATCAGTAATTCTCTAGCCACTCTGTTTGGAATCCAGCTCACTGGAGCTCATG
TACCACTACAAGACTATGAGGCCAGCAACAGTGTGACACCCAAAATGGTTGTATTGGAT
GCAGGGCGGTACCAGAAGCTAAGAGTTGAGAGTCCAGGATTCTGTCATTTCAACTCTTA
CAATCAGGAACAAAGATCAAATACATCTACTGGTTATTATCCATCTGGGGTGAAAATTT
CGGGCCCTCACAGCAGTGTTCGCGGAAGAGGAATTACCCGCTTACTAGAGAGCATCTCA
AACTCCTCCAACAACATCCATAGATTCTCCAGCTGTGAGACTTCACTCTCACCTTACAC
GCCCCAAAAAGATGGGTACAAACCTTTCTCCTCCTTTTCTTAATGATGGTACTTTGTGC
GATTTCTGGAAAAATAACAAGCCAACTTCCTTTCTGACTACAGTCATATTAACAAACAT
CACATCAATAGTAAATGTCACTCCTAAAACCTACTTAATTTGTAAGGAAACTATTTCAT
AGATTAAAAGTAATTGTGGTTGGAGAAG

Figure 38

SEQ ID NO.:38 Spg64 encoded prtoein sequence
MAREWRAAQGKDSGPSEKQKLVSTPLRRPGMLVPKPSISPPDMSNLSIKSDQALLGGIF
YFLNIFSHGELPPHCEQRFLPCEIGCVKYSLQEGIMADFHSFIHPGEIPRGFRFHCQAA
SDSSHKIPISNFEFGHDQATVLQNLYKFIHPNPGNWPPIYCKSDDRARVNWCLKRMERA
SEIRQDLELLTVEDLVVGIYQQKFLKEPSKTWVRSLLDVAMWDYSSNTRCKWHEENDIL
FCALAVCKKIAYCISNSLATLFGIQLTGAHVPLQDYEASNSVTPKMVVLDAGRYQKLRV
ESPGFCHFNSYNQEQRSNTSTGYYPSGVKISGPHSSVRGRGITRLLESISNSSNNIHRF
SSCETSLSPYTPQKDGYKPFSSFS

Figure 39a

SEQ ID NO.:39 Spg65 cDNA sequence
ggcacgagccaaagagtggcccaaaacctcagctcccatagaggatatcctatcccaac
cggagaaactcttatttgtcatcgacaacttggaagtgATGGAATGTGATATGTCTGAA
CGGGAGTCGGAGCTGTGTGATACCTGCACGGAGAAGCAGCCATTGCGTATCCTGCTGAG
CAGTTTGCTCAGGAGGAAGATGCTCCCCAAATCCTCTTTCCTCATCTCTGCTACCCCAG
AGACTTTTGAGAAAATGGAGGGCAGGGTTGAGTGCACAAATGTGAAAATAGTAACAGGA
TTCAATGAGAGCAATATTAAGATGTATTTCCGCAGCTTGTTCCAAGATAAGACCAAAAC
ACAGGAAATCTTCAGTTTGGTGAAAGAAAACCAGCAGCTGTTCACTGTATGTCAGGTCC
CTGTGCTCTGCTGGATGGTGGCCACTTGTCTAAAAAAAGAGATAGAGAAGGGAAGAGAC
CTGGTCTCTGTCTGCCGACGTACCACTTCCCTGTATACCACTCACATCTTCAATTTGTT
CATTCCCCAAAGTGCCCAATATCCAAGTAAGGAAAGCCAAGCTCAGCTTCAGAGCTTGT
GTTCTCTGGCCGCTGAGGGTATGTGGACTGACACATTTGTGTTTGGTGAGGAGGCTCTC
AGAAGAAATGGGATCATGGACTCCGACATCCCCACACTGCTGGACGTAAGGATCCTTGA
GAAGAGCAAGAAATCTGAAAAATCTTACATTTTCCTCCACCCGTCTATCCAGGAGGTCT
GTGCAGCCATCTTTTATCTGCTAAAGAGCCACATGGACCACCCTAGCCAGGATGTTAAA
AGTATAGAGGCACTCATATTTACATTTCTAAAGAAAGTCAAAGTACAGTGGATTTTTTT
TGGCTCTTTCATCTTTGGCCTTTTACATGAATCAGAACAAAAAAAGCTAGAGGCATTTT
TTGGCCACCAGTTGTCCCAGGAAATAAAACGTCAGTTGTATCAGTGCCTGGAAACCATA
AGTGGCAACGAAGAGCTTCAAGAACAGGTAGATGGCATGAAGCTGTTTTACTGTCTGTT

Figure 39b

TGAGATGGACGATGAAGCCTTCTTAGCACAAGCAATGAACTGTATGGAACAGATTAACT
TTGTGGCTAAGGATTATTCTGATGTTATTGTTGCTGCCCACTGCTTACAACACTGTTCT
ACACTGAAGAAACTATCCTTGTCAACCCAGAATGTCCTGAGTGAAGGTCAAGAACACAG
CTATACGGAAAAGCTACTCATGTGTTGGCATCATATGTGCTCTGTGCTCATAAGCAGTA
AGGACATCTACATACTCCAAGTGAAAAACACTAATCTCAATGAAACAGCCTCTTTGGTG
TTATATAGTCATCTGATGTACCCCAGCTGCACCCTTAAAGCACTTGTGGTAAATAATGT
GACCTTCCTATGTGATAACCGCCTGTTCTTTGAGTTGATTCAGAACCAGTGTTTGCAGC
ACTTGGACCTCAACCTCACATTCCTGTCCCATGGTGATGTGAAACTGTTGTGTGATGTC
TTGAGCCAGGAAGAGTGCAACATAGAAAAGCTGATGGTAGCAGCCTGTAACCTTTCACC
AGATGACTGCAAGGTCTTTGCCTCCGTTCTGATCAGCAGCAAGATGTTAAAGCATCTTA
ATTTGTCATCTAACAACTTGGACAAAGGGATATCCTCTCTGTCCAAGGCTTTGTGCCAC
CCAGACTGCGTTCTGAAGAACTTGGTGTTAGTCAACTGCTCCCTCAGTGAGCAATGTTG
GGACTACCTTTCGGAAGTTCTTAGGCGGAACAAAACACTGAACCACCTAGACATCAGCT
CCAATGACCTGAAGGATGAAGGGCTGAAGGTTCTCTGTAGGGCTCTGAGTCTCCCAGAC
AGTGTCCTGAAGTCACTAAGTGTAAGATATTGTCTCATCACCACTAGTGGTTGCCAGGA
CCTGGCTGAAGTCTTGAGGAAGAACCAGAACCTGAGGAACCTACAGGTTTCAAACAATA
AAATAGAAGATGCTGGTGTGAAGCTCCTGTGTGATGCTATAAAACATCCCAACTGCCAC
TTAGAGAATATTGGATTGGAAGCCTGCGCACTAACTGGTGCCTGCTGTGAGGACCTTGC
TTCTGCTTTTACCCACTGTAAGACCCTGTGGGGAATCAACCTGCAGGAGAACGCCTTGG
ACCACAGTGGATTGGTTGTACTGTTTGAGGCTCTGAAACAGCAACAGTGTACCCTGCAT
GTACTTGGACTTCGAATTACTGACTTTGATAAGGAAACCCAGGAGCTCCTGATGGCTGA
GGAAGAGAAAAACCCACACTTGAGCATCCTAAGCAGTGTGTAAggcagaagcagaaaac
aaaggtggatgttctgctgcaagaaacatggctgtgttctgacctcaaactacctccaa
aagaaagagagcaggatccttaatttggcccattatatacaaaaattacaggtcactaa
cattccaatgagatacatacagtttctttacctccccccccattcagatgtgttttgca
agatagatgtgactttttgtttgcactacagattcaaacaggccattcaaagacagtta
tggtaaaatgtctgccatataatgacagtttttcacacacttgtattctaagcatacaa
taaagttacttttaaagataaaagtatctttagaaatcccttaagaagagatttgcctg
ttggtggattactgggcctataatgtcggtccaggcaatgatggtgccccacaaagttc
tttagagaaatggacaaaggttggggaaatgatgatggaaactgttgctgttttgtgtt
ttttattaaataataaatttaggcattttctaaaaa

Figure 40

SEQ ID NO.:40 Spg65 encoded protein sequence
MECDMSERESELCDTCTEKQPLRILLSSLLRRKMLPKSSFLISATPETFEKMEGRVECT
NVKIVTGFNESNIKMYFRSLFQDKTKTQEIFSLVKENQQLFTVCQVPVLCWMVATCLKK
EIEKGRDLVSVCRRTTSLYTTHIFNLFIPQSAQYPSKESQAQLQSLCSLAAEGMWTDTF
VFGEEALRRNGIMDSDIPTLLDVRILEKSKKSEKSYIFLHPSIQEVCAAIFYLLKSHMD
HPSQDVKSIEALIFTFLKKVKVQWIFFGSFIFGLLHESEQKKLEAFFGHQLSQEIKRQL
YQCLETISGNEELQEQVDGMKLFYCLFEMDDEAFLAQAMNCMEQINFVAKDYSDVIVAA
HCLQHCSTLKKLSLSTQNVLSEGQEHSYTEKLLMCWHHMCSVLISSKDIYILQVKNTNL
NETASLVLYSHLMYPSCTLKALVVNNVTFLCDNRLFFELIQNQCLQHLDLNLTFLSHGD
VKLLCDVLSQEECNIEKLMVAACNLSPDDCKVFASVLISSKMLKHLNLSSNNLDKGISS
LSKALCHPDCVLKNLVLVNCSLSEQCWDYLSEVLRRNKTLNHLDISSNDLKDEGLKVLC
RALSLPDSVLKSLSVRYCLITTSGCQDLAEVLRKNQNLRNLQVSNNKIEDAGVKLLCDA
IKHPNCHLENIGLEACALTGACCEDLASAFTHCKTLWGINLQENALDHSGLVVLFEALK
QQQCTLHVLGLRITDFDKETQELLMAEEEKNPHLSILSSV

Figure 41a

SEQ ID NO.:41 Spg69 cDNA sequence

tggcagcattattcaggcaagcgccacgagagcttgcgcttcctgtcaggtctctgtga
gtttgaggccagcgggggagacagaggaccggagggctccggggcggctcggagacat
cttgcttctgtccatctctggaatcctttcctgaagatccatcaggATGAGCTGCAAGAC
TCCACCCACACTCCAGGAACTGGCAGAGAACAGCCTCCTGAAGAACCAGGACTTGGCTA
TCTCTGCTCTGGATGACATACCCTCACTTTTCTTCCCATCACTGTTC[illegible] AAAGGCCTGC
AGAAATAGATATGTTGGGATCATAAAGGCGATGGTGCAGGCGTGGCCCTTCCCCTGTCT
TCCTCTGGGGGCCATGATCAGTAGGAAGACTGCCTACAGGAGAATCTTAGAGATTATCC
TGTATGGGCTTGATGCCTTGCTTTCCCAGAAAGTTCCCCACAGCAGGTGCAAGCTGCAA
GTGCTGGATTTACGGGTTATGCCTTTGAAGCTGTGGAACAGGTTGCCTGTGTTTGGGAC
TGCTGGCTGCAGTGAGAATCCAGCAGTGGTGGGCCATTCGGGAACAGAGGTGAAACAGC
CAGTGAAGGTGCTGGTAGACCTGGTCCTCAAGGAAAGCCCACTAGATTCCACAGAGTCC
TTCCTCGTTCAGTGGGTGGATAACAGGAATGGTTTGGTGAGTTTGTGCTGTTGCAAGCT
GCAGATCTGGGCTATGTCCATGTATTACCACAGAAAACTTTTGGAGATTTTGGATCTGG
ACTCTGTCCAGGAGCTGCGTATGTACTGCATCAGTAATCCTGTCTGCCTGCTTAACTTC
GCCCCTTACTTGGGTCGCATGAGGAACCTGCGCTGCCTCATCCTCTCTCACCTCTGGCA
GACCTTCTCGATGACCCCGGTGGAGAAGCAGCAGGTTATTACCCAGTTCACGTCTCAGT
TCCTCAAACTGAAATGCCTCCAGATCCTGCATCTGGATACTGTCTTCTTCCTAGAGGGT
CATCTGGATGAGCTATTCTGGTGGCTGAAGACACCCTTAGAGACCCTGTCTGTGATTGA
TTGTAATCTCTCAAAATCAGACTGGTTCCATATATCTGAGTTCCAGTGCACAAGTCAGC
TAAAACACCTGAATTTGAAATGGGTCAAACTGACCCATTTGAGCCCAGAGCCCCTTCGA
GTTCTGTTACTAAAATCTGCATCTACCCTAACATCCCTGGATTTGGAGGGCTGTCAAAT
GATGGACTCTCAACTCAGTGCCATCCTACCTGCTCTGAGATGCTGTACACAGCTCACCA
AGTTTAATTTCCATGGGAACTATATCTCCATGCCTATCCTGAGGGAGCTGGCATATAAC
GTTGTCAAGCAGAAATCCCAACAGTCAAAGATACGCTTTATCCCAAGCTGTAGTCATCA
CAGTGGTCTGGAGTTTGAGGCCATTTCTCAGCCTCATATTGTGTTTGTAGATGTGGATC
GGACTACTGGGGAGCAAGAACAAGTCTTGTTTTATGCTATTTGTTCTGGAGAATATGTG
TTATGAtatctctacaatgtattaggacttgttagactcctacctaatgagatacagat
ttaagctctcttgtggacactgggatgtgtctggtcagagtatgcacaacacatgcttt
tagactgcagttcttgcgagtgagaagagaaagttgatgctagagtgcaaacaagtgag
agtatttgacatagggaatgtgggacacattgacagaagtcatgggagtgggttctggt
tgggcaggtacaaaagggcattcctccagcctggtgtttttttgatttttgtagtaaaa
aatgggaccatctgtcctacctggatgattcaaatcctgtgactgctaggaacaaactt
gttttatgctatttgctggttcttctactttgatcttctgagtgctgagtataggctta
tagcaccagacctggttccctgtagttcctttaacatgtggctgtacctctcatctttc
tagtcaaacccagtattttatatagtagcagttgttgtggggctagagagatggcttat
cagttgagagcacttgatgcttttgtagagtacctgggtttgattccccacatttacat
ggtggctcacagtcatccagaactacttatggggtgcatgaggcatgcatgtagtgcat
agacatacatgtaggtgaaacactcagacatgtaactctaaaataatttaaaattgat
ttgtactgatgagactgaatgtctagttgaggcagccagcacccagtatttctatgaca
gacactgctaagtcatgtatttatactcgtaaaatgctacctatgagcttagcaaattg
aaccaggaatatatggtgagtagacaataaactctagcaggaaaaaccccaagctttt
atgacaatattaaacaccccagaccactgaaggatgcaatccccatcccgaatcatcta
aagaggggcatcaggtactgagccatcagactgggttgaaatgagctcctgactctgtc
cctaggctacagcacaactgaaccccactgctgaacctctttaatttttttgtggtcaa
tgaactgtgtctacaaatgaggctgtggttaaacgtcaggtgtctgtgtatcttgctcct
cattcacttgacaaggctttcatggaaccagaagcttgatggttcacctagacctagga

Figure 41b

ctgttagccagagggctcctataggtctgccagtccctgtgctggagtcacaggctcat
gcatctatggctgaccctcttctgtcccccataccctccgcttcctgaataatgctgca

Figure 42

SEQ ID NO.:42 Spg69 encoded protein sequence

MSCKTPPTLQELAENSLLKNQDLAISALDDIPSLFFPSLFKKACRNRYVGIIKAMVQAW
PFPCLPLGAMISRKTAYRRILEIILYGLDALLSQKVPHSRCKLQVLDLRVMPLKLWNRL
PVFGTAGCSENPAVVGHSGTEVKQPVKVLVDLVLKESPLDSTESFLVQWVDNRNGLVSL
CCCKLQIWAMSMYYHRKLLEILDLDSVQELRMYCISNPVCLLNFAPYLGRMRNLRCLIL
SHLWQTFSMTPVEKQQVITQFTSQFLKLKCLQILHLDTVFFLEGHLDELFWWLKTPLET
LSVIDCNLSKSDWFHISEFQCTSQLKHLNLKWVKLTHLSPEPLRVLLLKSASTLTSLDL
EGCQMMDSQLSAILPALRCCTQLTKFNFHGNYISMPILRELAYNVVKQKSQQSKIRFIP
SCSHHSGLEFEAISQPHIVFVDVDRTTGEQEQVLFYAICSGEYVL.

Figure 43a

SEQ ID NO.:43 Spg70 cDNA sequence

ggcacgagtaggcctgtacagcaaagtttgaacaagcttgaagataataaatcaccatt
tgaaacaaaggccattgaagtgaagagtgaggttgactgtcccccgggagttactaaag
aaataacagcgggtgctgagagagtaATGTTCTCTGATTTGAGAAGTCTCCAACTCAAG
AAAACCATGGAGATAAAGGGTACAGTTACTGAATTCAAGCACCCGAGTAACTTTTATAT
CCAGTTGTATTCTTCAGAGGTTCTAGAAAACATGAACCAACTCTCTACAAGCTTGAAAG
AGACATATGCAAATGTGGTGCCTGAAGATGGTTATCTTCCTGTTAAGGGGAAGTTTGT
GTTGCCAAATACACAGTTGATCAGACCTGGAACAGAGCCATAGTACAAGCCGTGGATGT
GCTGCAGAGGAAGGCCCACGTCCTGTACATTGACTATGGGAACGAGGAGATGATCCCGA
TAGACAGCGTTCACCCGCTGAGCAGAGGCCTTGACTTGTTTCCTCCTTCTGCCATAAAG
TGCTGTGTGTCAGGCGTCATTCCCACTGCGGGCGAGTGGAGTGAAGGCTGTGTTGCAGC
TGTCAAGGCCCTTCTGTTTGAGCAGTTCTGCTCTGTCAAGGTCATGGACATCTTAGAGG
AGGAGGTACTCACCTGTGCCGTTGACCTTGTTCTACAGAGCTCAGGAAAGCAGCTGGAC
CATGTGCTGGTGGAAATGGGGTATGGAGTGAAACCCGGTGAGCAGAGCTCCACGGAGCA
GAGTGTGGACCACAGTGCATTGGAGGACGTTGGAAGAGTGACAGTTGAGAGCAAGATTG
TGACAGACAGAAATGCCCTGATCCCCAAAGTGCTGACTTTGAATGTGGGTGATGAGTTC
TGTGGCGTGGTTGCCCACATCCAGACACCAGAGGACTTCTTTTGTCAGCAGCTGCAGAG
CGGCCACAAGCTTGCGGAGCTTCAGGAATCCCTCAGTGAATACTGTGGCCATGTGATTC
CACGCTCTGACTTTTATCCAACCATTGGGGACGTGTGCTGTGCTCAGTTCTCAGAGGAT
GATCAGTGGTACCGCGCCTCGGTTCTGGCCTACGCTTCTGAAGAATCTGTCCTGGTTGG
ATATGTCGATTATGGGAACTTTGAGATTCTCAGTCTGAAAAGACTTTGTCCCATAATTC
CAAAGTTGTTGGATTTGCCGATGCAAGCTCTAAATTGTGTGCTGGCAGGCGTGAAGCCA
TCATTAGGAATTTGGACTCCAGAAGCTGTGTGTGTCATGAAAGAGATGGTACAGAACAG
GATGGTCACAGTGAGAGTGGTGGGCATGCTGGGGACCAGGGCCCTGGTGGAGCTCATCG
ACAAGTCGGTGGCTCCTCACGTCAGCGCTTCTAAAGCTCTCATAGACTCGGGCTTTGCC
ATCAAAGAAAAGGACGTGGCAGATAAAGGCAGCAGTATGCACACAGCCAGTGTTCCCTT
GGCCATTGAAGGTCCAGCAGAGGCGTTGGAGTGGACGTGGGTGGAGTTCACTGTTGACG
AGACCGTGGATGTGGTGGTCTGCATGATGTACAGTCCCGGGGAGTTCTACTGCCACTTT
CTTAAAGATGATGCCTTAGAGAAGCTCGATGACTTGAATCAGTCCTTAGCAGACTACTG
TGCACAAAAGCCGCCCAATGGCTTTAAGGCAGAGATAGGGCGGCCTTGCTGTGCCTTTT
TTTCAGGTGACGGCAACTGGTACCGGGCTCTAGTCAAGGAGATCTTACCAAGTGGGAAT
GTTAAAGTCCACTTTGTGGATTACGGAAATGTTGAAGAAGTTACCACAGACCAACTCCA
GGCGATATTACCACAGTTCTTACTACTTCCATTTCAGGGGATGCAGTGCTGGCTAGTAG
ATATACAGCCCCCAAACAAGCATTGGACAAAAGAGGCCACAACAAGATTTCAAGCATGT
GTTGTGGGGCTCAAACTCCAAGCCAGAGTTGTGGAAATCACCGCGAACGGCGTGGGCGT

Figure 43b

GGAGCTCACCGATCTTTCCACTCCTTACCCCAAAATCATTAGTGATGTGCTCATCAGAG
AGCAGTTGGTCTTAAGGTGTGGTTCACCACAGGACTCACTGATGAGCAGACCTGCTAAT
CAACATAAGCAGATCGACAGCCACAGGGTGCAAGCCAGCCCTTCAACAGAGCAGTGGAA
GACAATGGAATTGCCAGTTAACAAGACTATAGCAGCAAATGTACTAGAGATCATAAGCC
CAGCCTTGTTCTACGCCATCCCCAGTGAAATGTCAGAAAATCAAGAGAAGCTGTGTGTG
TTAGCAGCTGAATTGTTAGAACACTGTAATGCTCAGAAGGGCCAGCCAGCCTACAGACC
ACGGACCGGCGACGCGTGCTGTGCTAAGTACACAAATGATGACTTCTGGTACCGGGCCA
TTGTTCTGGAAACGTCGGAATCTGATGTGAAAGTTCTCTACGCAGATTATGGAAACATC
GAAACCCTGCCTCTTTCCAGAGTGCAGCCCATCCCAGCCAGCCACCTGGAGCTGCCCTT
CCAGATCATTAGATGCTCACTAGAGGGGCCGATGGAGCTGAATGGAAGCTGTTCGCAGT
TAGTGATGGAGCTGCTGAGAAATGCCATGCTGAACCAGAGTGTGGTTCTCTCTGTGAAA
GCCATTTCAAAGAATGTCCACGCAGTGTCAGTTGAAAAATGTTCTGAGAACGGAATGAT
CAATATAGCTGAGAATCTGGTGATGTGTGGCCTGGCAGAAAACCTCACTTCTAAAAGGA
AAAGTGCTTCCACTAAAGAGATACCACACAGCAGAGACTGCTGTTGCACAGAGTTACAG
AAACAGATTGAGAAACACGAACAGATTCTCCTCTTCCTCTTAAACAATCCAACCAACCA
AAGTAAATTCACAGAGATGAAAAAGCTGCTGAGAAGCTAAaaacatcatctcttggaaa
taaacactgggaagaaagagacagcaaacgccagaaaaa

SEQ ID NO.:44 Spg70 encoded protein sequence Figure 44

MFSDLRSLQLKKTMEIKGTVTEFKHPSNFYIQLYSSEVLENMNQLSTSLKETYANVVPE
DGYLPVKGEVCVAKYTVDQTWNRAIVQAVDVLQRKAHVLYIDYGNEEMIPIDSVHPLSR
GLDLFPPSAIKCCVSGVIPTAGEWSEGCVAAVKALLFEQFCSVKVMDILEEEVLTCAVD
LVLQSSGKQLDHVLVEMGYGVKPGEQSSTEQSVDHSALEDVGRVTVESKIVTDRNALIP
KVLTLNVGDEFCGVVAHIQTPEDFFCQQLQSGHKLAELQESLSEYCGHVIPRSDFYPTI
GDVCCAQFSEDDQWYRASVLAYASEESVLVGYVDYGNFEILSLKRLCPIIPKLLDLPMQ
ALNCVLAGVKPSLGIWTPEAVCVMKEMVQNRMVTVRVVGMLGTRALVELIDKSVAPHVS
ASKALIDSGFAIKEKDVADKGSSMHTASVPLAIEGPAEALEWTWVEFTVDETVDVVVCM
MYSPGEFYCHFLKDDALEKLDDLNQSLADYCAQKPPNGFKAEIGRPCCAFFSGDGNWYR
ALVKEILPSGNVKVHFVDYGNVEEVTTDQLQAILPQFLLLPFQGMQCWLVDIQPPNKHW
TKEATTRFQACVVGLKLQARVVEITANGVGVELTDLSTPYPKIISDVLIREQLVLRCGS
PQDSLMSRPANQHKQIDSHRVQASPSTEQWKTMELPVNKTIAANVLEIISPALFYAIPS
EMSENQEKLCVLAAELLEHCNAQKGQPAYRPRTGDACCAKYTNDDFWYRAIVLETSESD
VKVLYADYGNIETLPLSRVQPIPASHLELPFQIIRCSLEGPMELNGSCSQLVMELLRNA
MLNQSVVLSVKAISKNVHAVSVEKCSENGMINIAENLVMCGLAENLTSKRKSASTKEIP
HSRDCCCTELQKQIEKHEQILLFLLNNPTNQSKFTEMKKLLRS

SEQ ID NO.:45 Spg85 cDNA sequence Figure 45a

ccactgaagaaagagaaggtgggctcatcatcagcctggaccacttccttctctccaat
gactggaagagatcctgggtaagtaagctgcatccctgaggtgagataaaacttcccaa
agccaaagctgtagatatttgggcagaaatgattccaggtttaagctgtcggttggga
gaactatttgggcttccctgaatgaggctatcatccagggcttctcctatgaccttctg
aagaagatagactctcctcagcgactcatcggcagcccaccctggtttggtagcctcat
tcagggaagcccaaatagttctcccaaccgacagcttaaacctggaatcatttctgccc
aaaatatctacagctttggctttgggaagctttatctcacctcagggATGCAGCTTACT
TACCCAGGATCTCTTCCAGTCATTGGAGAGAAGGAAGTGGTCCAGGCTGATGATGAGCC
CACCTTCTCTTTCTTCAGTGGCCCCTACATGGTCATGACTAACCTCGTGTGGAATAGGA
GCAGAGTCACAGTAAAGGAGCTGAACCTTCCCACCCGTCCCCACTGTAGCAGGCTGAGG
TTGGCCGACTTGCTGATTGCTGAGCAGGAGCACAGCAGCAACCTGCGGCATCCTAACCT

Figure 45b

GCTGCAACTGATGGCTGTATGTTTGTCCCGGGACCTGGAGAAAATTCGCCTGGTTTACG
AGCGTATCGCAGTCGGCACACTGTTCAGTGTCCTCCATGAACGAAGGTCCCAGTTCCCA
GTGCTGCACATGGAGGTGATTGTGCACCTGTTGCTCCAGGTTGCTGATGCCTTGATATA
CCTGCATTCCCGGGGGTTCATCCACCGCTCCCTCAGCTCCTACGCTGTCCACATCGTCT
CTGCAGGAGAAGCAAGGCTGACTAACCTGGAATACCTGACGGAAAGCCAGGACAGTGGT
GCACACAGGAACGTGACTCGAATGCCCCTCCCCACCCAGCTGTACAACTGGGCTGCACC
AGAAGTGGTCTTGCAGAAGGCAGCCACGGTGAAGTCAGACATATACAGCTTTTCCGTGA
TCATACAAGAGATCTTAACAGACAGTATACCCTGGAATGGCTTGGATGGCTCACTTGTT
AAAGAAACCATAGCCTTGGGAAATTATTTAGAAGCTGATGTCAGGCTTCCGGAACCTTA
CTATGATATTGTTAAGTCAGGAATCCATGCCAAGCAGAAGAACCGAACAATGAACCTTC
AAGATATTCGTTATATTCTGAAGAATGACTTAAAGGAATTTATTGGAGCTCAGAAAACT
CAGCCAACCGAGAGCCCCAGAGGGCAGAGCTATGAACCCCATCCTGATGTTAATATCTG
CCTAGGTCTAACTTCAGAATATCAAAAGGACCCTCCAGACTTGGACATCAAGGAACTAA
AGGAAATGGGTAGTCAGCCCCATTCACCTACAGATCACTCCTTTCTCACTGTAAAACCA
ACACTAGCTCCTCAGACCCTAGATTCAAGTCTGTCAGCCCAGAAACCTGACAATGCAAA
TGTTCCTTCTCCTCCTGCTGCATGTCTGGCAGAAGAGGTCAGGAGCCCCACTGCAAGTC
AGGACAGCCTCTGCAGCTTTGAAATCAATGAGATCTACTCAGGCTGCTTGACACTGGGA
ACTGACAAGGAGGAAGAGTGTCTGGGGACTGCTGCTTCACCTGAGGGGGATAGACCAAA
CCAGGGAGATGAGCTGCCATCCCTGGAAGAAGAGCTCGATAAGATGGAGAGAGAATTGC
ACTGTTTTTGTGAAGAGGACAAAAGCATTTCAGAAGTTGACACAGACCTTCTTTTTGAG
GATGATGACTGGCAAAGTGATTCTCTTGGTTCACTCAACCTGCCCGAACCAACCAGAGA
AGCCAAGGGCAAAACGAGCAGCTGGTCCAAGACTGATGAGTATGTCAGTAAGTGTGTGC
TGAATCTGAAGATTTCACAGGTGATGATGCAGCAGAGCGCTGAGTGGCTGAGGAAGCTT
GAGCAGGAGGTAGAGGAGCTCGAGTGGGCACAGAAGGAGCTGGACAGTCAGTGCAGCAG
TTTGCGGGATGCTTCATTAAAGTTTGCAAATGCCAAGTTCCAGCCGGCTGTAGGCCCTC
CATCTTTGGCCTATCTTCCTCCTGTTATGCAATTACCAGGGCTCAAGCAGCCTGAAAAT
GGTGGCACCTGGTTAACCCTAGCAAGGTCTCCAGGAAATGAGAGAGAGTTCCAAGAGGG
ACATTTTAGCAAAAAACCTGAGAAACTAAGTGCCTGTGGCTGGAAGCCTTTTACACAAG
TGTCTGAAGAAAGCAGAGGGGACTGCTCAGAGCTAAACAATCAGCTGCCGACTCTTCGT
GGTCCTGGGAAGCAGAGCACAGGTGAGCAGTTACCATCCACTCAAGAAGCAAGGGAGAG
TTTGGAAAAAAATACAAACCAAAATAGTAGGAGTATGGCGTCTGTGTCTTCTGAAATCT
ATGCTACTAAGTCAAGAAATAATGAGGATAATGGAGAGGCACACTTGAAATGGAGATTG
GCAGTAAAAGAAATGGCAGAGAAAGCAGTTTCCGGACAGCTCTTATTACCTCCTTGGAA
TCCTCAGAGTAGTGCGCCTTTTGAGAGTAAGGTTGAAAATGAGAGCACTCCTTTGCCAC
GGCCCCCAATTAGAGGTCCTGAGAGCACAGAATGGCAGCACATTTTAGAATACCAGAGG
GAAAATGATGAGCCCAAAGGAAATACGAAGTTTGGCAAAATGGACAACAGTGACTGTGA
CAAGAACAAGCACAGCAGATGGACAGGCCTCCAGCGCTTCACTGGTATTAGATACCCAT
TCTTCAGAAACCACGAGCAGCCAGAGCAGAATGAAGCCTCTCAAGCAAGCTGTGACACG
TCTGTGGGCACTGAGAAGTTCTACAGCACCTCAAGTCCCATAGGAGACGACTTTGAAAG
ATTCCAAGATTCTTTTGCCCAACGTCAAGGCTATGTTGAAGAAAATTTCCAAATAAGAG
AAATATTTGAAAAGAATGCTGAGATTTTGACCAAGCCTCAGTTTCAAGCTATTCAATGT
GCTGAAGACAAACAAGACGAAACATTAGGGGAGACGCCAAAGGAACTGAAAGAGAAAAA
CACATCACTGACAGACATTCAAGACTTGTCCAGCATCACCTATGATCAAGACGGCTATT
TTAAGGAAACCTCATACAAAACACCCAAATTAAAACACGCACCAACTAGTGCCAGTACC
CCGCTAAGCCCAGAGTCGATTTCTTCAGCTGCTAGTCACTATGAAGACTGCCTTGAAAA
TACCACATTTCATGTTAAAAGAGGATCTACATTTTGTTGGAATGGCCAAGAAGCTATGA
GAACTTTGTCTGCCAAATTTACAACTGTCCGAGAGAGAGCTAAGAGCCTGGAATCACTT
CTCGCTTCTTCTAAAAGCCTACCTGCCAAGCTGACTGACTCCAAGAGATTGTGTATGTT

Figure 45c

GAGTGAGACTGGCTCTTCTAACGTTTCTGCGGCATTTGTAACATCAACTCATGCTACCA
AGAGGAAGAGCCTACCCAGAGAACTGGCAGAAGCCACCTCTCAACAGCATCTTGATGAG
CTTCCACCACCAGCTCAGGAGCTACTTGATGAAATTGAGCAACTGAAGCAGCAGCAGGT
CTCATCCCTGGCGTCACATGAGAACACGGCACGTGATCTGAGTGTCACTAACAAGGATA
AGAAGCATTTGGAAGAACAAGAAACCAACAGTAGTAAAGACAGCAGTTTTCTTTCCAGC
AGAGAAATTCAGGATCTGGAAGATACAGAGAGAGCTCATTCTTCTCTTGATGAGGACCT
GGAAAGATTCCTGCAGTCACCTGAGGAGAACACGGCACTGCTGGACCCTACCAAGGGCT
CTACAAGGGAGAAAAAAAACAAAGATCAAGACGTTGTTGAGCAGAAGAGAAAAAAGAAA
GAAAGCATCAAGCCAGAGAGAAGGGAGTCAGACAGCTCCCTAGGGACCTTGGAAGAAGA
TGAACTAAAACCCTGTTTTTGGAAGCGACTGGGTTGGTCCGAACCTTCCAGGATAATTG
TGCTGGATCAGAGCGACTTGTCAGACTGAttggaactggaccgtgcaagcattgtggct
gtggcctcctttcttctcttatctgcttcagttgcctcaaggacagtagtttcagtctg
taactcacactttgttctgctgctactatgggcacaataatgtgtccctatcatgtgta
gcatgcttaatcatttgttttaaatcaggtttctgaaaagtgcaaagtaaccatagtgg
caaacattttgtgttcagaatggcttttgtttttctgatgtaaattttgaaaccata
actttgttatat<u>aataaa</u>gtgtttactttcaatgct<u>aaaaa</u>

Figure 46

SEQ ID NO.:46 Spg85 encoded protein sequence
MQLTYPGSLPVIGEKEVVQADDEPTFSFFSGPYMVMTNLVWNRSRVTVKELNLPTRPHC
SRLRLADLLIAEQEHSSNLRHPNLLQLMAVCLSRDLEKIRLVYERIAVGTLFSVLHERR
SQFPVLHMEVIVHLLLQVADALIYLHSRGFIHRSLSSYAVHIVSAGEARLTNLEYLTES
QDSGAHRNVTRMPLPTQLYNWAAPEVVLQKAATVKSDIYSFSVIIQEILTDSIPWNGLD
GSLVKETIALGNYLEADVRLPEPYYDIVKSGIHAKQKNRTMNLQDIRYILKNDLKEFIG
AQKTQPTESPRGQSYEPHPDVNICLGLTSEYQKDPPDLDIKELKEMGSQPHSPTDHSFL
TVKPTLAPQTLDSSLSAQKPDNANVPSPPAACLAEEVRSPTASQDSLCSFEINEIYSGC
LTLGTDKEEECLGTAASPEGDRPNQGDELPSLEEELDKMERELHCFCEEDKSISEVDTD
LLFEDDDWQSDSLGSLNLPEPTREAKGKTSSWSKTDEYVSKCVLNLKISQVMMQQSAEW
LRKLEQEVEELEWAQKELDSQCSSLRDASLKFANAKFQPAVGPPSLAYLPPVMQLPGLK
QPENGGTWLTLARSPGNEREFQEGHFSKKPEKLSACGWKPFTQVSEESRGDCSELNNQL
PTLRGPGKQSTGEQLPSTQEARESLEKNTNQNSRSMASVSSEIYATKSRNNEDNGEAHL
KWRLAVKEMAEKAVSGQLLLPPWNPQSSAPFESKVENESTPLPRPPIRGPESTEWQHIL
EYQRENDEPKGNTKFGKMDNSDCDKNKHSRWTGLQRFTGIRYPFFRNHEQPEQNEASQA
SCDTSVGTEKFYSTSSPIGDDFERFQDSFAQRQGYVEENFQIREIFEKNAEILTKPQFQ
AIQCAEDKQDETLGETPKELKEKNTSLTDIQDLSSITYDQDGYFKETSYKTPKLKHAPT
SASTPLSPESISSAASHYEDCLENTTFHVKRGSTFCWNGQEAMRTLSAKFTTVRERAKS
LESLLASSKSLPAKLTDSKRLCMLSETGSSNVSAAFVTSTHATKRKSLPRELAEATSQQ
HLDELPPPAQELLDEIEQLKQQQVSSLASHENTARDLSVTNKDKKHLEEQETNSSKDSS
FLSSREIQDLEDTERAHSSLDEDLERFLQSPEENTALLDPTKGSTREKKNKDQDVVEQK
RKKKESIKPERRESDSSLGTLEEDELKPCFWKRLGWSEPSRIIVLDQSDLSD.

Figure 47a

SEQ ID NO.:47 Spg87 cDNA sequence
ACAGGTTTCAGGCTTAGGAAGAAAGGGGTAGTAGTCCAGGAACTCTTTCTTCATGGTAG
GAATAACTTAATAGATGTGTTACAGTTGGGAATATCGGATTTCCTCTGGCCCAGGTGTC
CAGGTGAGCACTTCAGGCATTACTGAGGAATCTGTGTTGCTGTATTACTGTTCCGTGAT
GTCAAACCCTGTTTTCCACACAGTATAACGCAACAGCATAGTGTATAGTATTATAGACC
AGACAGCTTGGGCCTGGAATTATTGCTCCCCCACACCTATCCCTACCCACACCTCAGGC
AAAACAAGCAAAAAGCCCCAAATCTACTTTTGAGCAAGAGGGTGTGCTCAGGAAGAAGG

Figure 47b

AACACACAGAGGAAGTATACTTGGTTTTTATTCCGAGGAAGGTGGTAATTGTATCCTTT
CCCCTTTGGCTGGGGTCTGAACCTCTGCTAGTCTGAGAATTGGTGCATAAGAAAATGGA
GGAAGGGGAAAGGAGTTATTGCTCCAAAGAGGAAAGGATCATTGCTTCAGGCTACCAAA
TTCTTAGAATAGAAATAGGACCTTTGAGTAAATAAAAGTTTTACTTGAAGTGGGGGGAG
GGATTAACTCCTAAACACAAGTTTTATAGTATTTGATAGAAAAAAAATCTCATTATATA
TTTCTTATAAATCCTTCCTCTTTTTTCCTTTTAAAACACTCTTTTCTTCAAACTCATT
GTGGTTTTCTTTTTCTGTTCTATCTTGGAATAAGAAACTGCCCTGGGGAGGGAGTAGTA
CCTGTTTATTAATAGTCAACTCAACTATCCTATGTTATGTTCCTAGAATAAAAAATTGT
TACATCTATTTCATTACCATGGTTTAAGGTAAGCTCACCTTCCTAAGGGTAGTTCCTCT
GTCAGGAGAATGATCTATCTGCTTTGGAATCATTGCCCTTTGATGTGCAAAGGAGTTTG
CCTCCTTTTAAGTGAAGTATCCAGGGTGTGGGGCTCCAGAAAGTATTACAGTGTTTTAA
ATGTAGCATTTGCTTGTAATATTTGTAACATACATTTAGGCACTTGTGAATCTTCTTTG
ATAATTGGGACACATTCGTCAATTCTGAGAACTTGTTATTTTTTTCTATTTTCATAGT
GTTTACTGTGAATTAAAATTTGTTATGCCACTGCCAAAAAATAAAGCTTACTTTGGAAC
ACAAAAA

Figure 48

SEQ ID NO.:48 Spg87 encoded protein sequence
MIYLLWNHCPLMCKGVCLLLSEVSRVWGSRKYYSVLNVAFACNICNIHLGTCESSLIIG
THSSILRTCYFFSIFIVFTVN

Figure 49

SEQ ID NO.:49 Spg84 cDNA sequence
TTTTCCCAGGGAAGAGAAGGGAAGGAAAAGTCAGCATGTGTCACAGGATGATTATACGA
TAGGAATACAAGGGCCCGGGTACAGTAAAAATCAACTAGGAAATAAAACACCCCAGGCA
GGGGTGGGGGTCATCCAAGCCCCGGGGGTAGGGGGGCCTTAGTCTCCTGCAGTTCAGGA
AAGAGATGGGGAAAGGACAGACAAGTACACCCTTTCCCACCCTCCCCATAAATTCAAGA
TTTCTCACAAAGCTTTGGTTTCTAGCAGTAAACATGGAGATACATTCGTCCGTCTCCTA
GTAACAATCTTGTGGCCTCTTTGACATAAGTTTCTTGCACCGGCATTAAGTTCCTGAGT
GACTCACTGTACATTCATAGTCCCTTTTCTGGTGTCCAGATTCCAACTTTCTACATGGA
AGGCCCCACAGTTGCTTCTCTCGACCTAAGGGCGACAGATTACATTGGTTTGATCCATC
CAAAGGCGAATCACACCATGAAATAAATGGTCTTGCCAGGGAGAAGCGGCACCTGCAAG
CCCTGCACAGGGGACTCTGTGCAGAAGGCAGGAGGAGAGCCAGGAACCCGAGGCTCTCT
ATCTCCAGCTACAGAGTGAGGCCCTGTCTCAAAACCACCAACCAAAACTCTTCACTGAG
TTAGGGACAAGGAAAGAATGAGGTTCCTGGCTTCTTCAGAATTTTCACATGGGTCCTTC
AAGAGTTACAGAGATGCTCAAAGAAGTAAATGAGCCTAAGTTTTCTTACGAGGGAGAAG
AGGGGCTGTCTGAAGGTCACTGTGGTCCAGAATGGGAGACACAGGAGGAGCAGGTAAGG
ATAAGCCATGGTCCCAGAGGTTCGCTTTGAGAAGAGGACCGCACATTTAAGTTTCAGAT
GGTGTTGTCTGGTGCAGAGCTTTCTGTCAAAGATGCTTTGGCTATTTTTCTCTCAATAC
AACAAAAGTTTTGTAAACAATAAAACCCCAAAAGAACATGAAGACCAACACATTTATTT
TTACACAACTNGGCCACCTAGCAATCACCAACTCAGAGACAGTAAAAGTCCTACAAAGG
CCAGACGAATACAATTAACTAGGGGTGAGGGCAGCATTTGGGGGGAGAGGGAGACAAGA
AACCAAGATCAGACACACACACACACCACCCAATGTGTTCTATTGCATTTGTCCCGTTT
CAACACAGTGAGGTAGGTTTGTGGCGATCTCAAAGCATGTAAACGAAACTCCCCACCCC
CTCTTTCCTTTAGCTATCAACCATCACGCTACAGCAGGGCAGGACACTTGCCACTGAGG
CCCATACTCATGAGTCTCTCAGAAAGCCAAGATTGTGAAAGGCTAAGGAGTTGAGTCCC
TGCCTCATGTTCCCATGCCTGGACAGCACAGTGTGGGAATAAGGGTACTGGTCTTAAGT
TGCATTCTTACTGGGATAACTCAGTGGCAGTGTACTTCCTAGCACAAATGAAGCCCAAG
ATTCCATCCCCAGCACAAAAAGCAATCAAATAAACAAAACCCACCTCGCCCACGCGTCC
GCCCACGCGTCC

Figure 50

SEQ ID NO.:50 hSPG1 cDNA sequence

TTCGCCTCTACGTTCCGCGCGGGAGCCCACGCGCGGTTCGTCCGGAACCCACAGACCAG
AGACGCAGGTCCCAGCCTTTTCGGTGTCGGCGCCAGTTCCCGGAGGAGCGGACATGAGT
GAAAGCCAGGATGAAGTTCCTGATGAAGTTGAGAACCAGTTTATATTGCGTCTGCCTCT
GGAACATGCTTGTACTGTCAGGAACCTAGCACGTTCTCAAAGTGTCAAGATGAAGGATA
AACTAAAAATTGACTTATTGCCTGATGGGCGCCATGCAGTTGTTGAAGTAGAAGATGTC
CCACTAGCTGCTAAGCTGGTTGACTTGCCTTGTGTTATTGAAAGCCTGAGAACGCTTGA
TAAAAAAACCTTTTATAAAACAGCAGACATTTCTCAGATGCTTGTGTGCACTGCTGATG
GTGATATCCACCTTTCTCCAGAAGAACCAGCTGCCTCTACTGATCCTAATATAGTCAGG
AAAAAAGAAAGGGGGAGAGAAGAAAAATGTGTCTGGAAGCATGGCATTACGCCACCACT
TAAGAATGTCAGAAAGAAAAGGTTCCGGAAAACACAAAAAAAGGTCCCTGATGTCAAAG
AAATGGAAAAAAGCAGCTTTACTGAGTACATTGAATCTCCAGACGTGGAAAATGAAGTA
AAGAGACTGCTGCGTTCGGATGCTGAAGCCGTAAGTACCCGTTGGGAAGTCATTGCTGA
AGATGGAACCAAGGAAATAGAAAGTCAAGGCTCCATCCCAGGATTTTTGATATCCTCGG
GAATGAGCAGCCACAAGCAGGGTCATACCTCGTCAGAATATGATATGCTTCGGGAGATG
TTCAGTGATTCTAGAAGTAACAATGATGATGATGAGGATGAGGATGATGAAGATGAGGA
TGAGGATGAGGATGAAGATGAAGACAAAGAAGAGGAGGAGGAAGATTGTTCTGAAGAGT
ATCTGGAAAGGCAGCTGCAGGCCGAGTTTATTGAATCTGGCCAGTATAGGGCAAATGAA
GGTACCAGTTCAATAGTCATGGAAATTCAGAAGCAGATTGAGAAAAAGGAGAAAAAGCT
CCATAAGATTCAGAATAAAGCACAAAGACAGAAGGATCTCATCATGAAAGTGGAAAACC
TGACACTCAAGAATCATTTTCAGTCTGTGCTGGAGCAGCTTGAGTTACAGGAAAAACAA
AAAAATGAGAAGCTCATTTCCCTACAGGAACAGTTGCAGCGTTTTCTGAAGAAGTGAGG
AGAGCCATTGGCGTGGCCCACAAACCTTGGATTCACCATCCAGACTGCAGATTGGATGA
AACTGTGCACGTTTTTGTCCCTTCAGTTGCCTTATGTTGAATCAGTTATATTTATCTGT
ACCTTCTTTGCTACTTAAAATATGCTCACAGTTTGTAGTCATGTAGAAAAGGCCAGTAT
AAAAATGTAGTAGACTTAAAGACCCCACTCGACCATGAGACTTTCTCTTTGTCAATTTG
GGAATTATTATTATTAATTTAGAAATGGGGTCTTGTTATGTTGCCCAGGCTGAATTCAG
ACTCCTGGGCTTAAGGGATCCTTCCGCCTCAGCCTC

Figure 51

SEQ ID NO.:51 hSPG1 encoded protein sequence

MSESQDEVPDEVENQFILRLPLEHACTVRNLARSQSVKMKDKLKIDLLPDGRHAVVEVE
DVPLAAKLVDLPCVIESLRTLDKKTFYKTADISQMLVCTADGDIHLSPEEPAASTDPNI
VRKKERGREEKCVWKHGITPPLKNVRKKRFRKTQKKVPDVKEMEKSSFTEYIESPDVEN
EVKRLLRSDAEAVSTRWEVIAEDGTKEIESQGSIPGFLISSGMSSHKQGHTSSEYDMLR
EMFSDSRSNNDDDEDEDDEDEDEDEDEDKEEEEEDCSEEYLERQLQAEFIESGQYRA
NEGTSSIVMEIQKQIEKKEKKLHKIQNKAQRQKDLIMKVENLTLKNHFQSVLEQLELQE
KQKNEKLISLQEQLQRFLKK

Figure 52a

SEQ ID NO.:52 hSPG3a cDNA sequence

aaaggtgggagttctttccgggataattttgacaagaggagctgtcattatgaacatgg
tgggtatgagcgcccgcctccacactgccaggagaatgatggaagcgtggagATGAGGG
ATGTCCACAAGGACCAACAACTAAGACACACTCCTTATAGCATCCGATGCGAAAGAAGA
ATGAAATGGCATAGTGAAGACGAAATCCGTATTACCACGTGGAGAAATAGAAAACCTCC
GGAGAGAAAAATGAGTCAGAACACACAGGATGGATACACAAGGAACTGGTTTAAGGTCA
CAATTCCTTACGGGATAAAGTATGACAAGGCATGGCTAATGAATTCAATCCAGAGCCAT
TGCAGTGACCGCTTCACTCCGGTTGATTTCCACTACGTCCGAAATCGGCATGCTTCTT
TGTCCAGGATGCTAGCGCTGCCTCCGCATTGAAGGATGTCAGTTATAAGATTTATGATG

Figure 52b

ATGAGAACCAAAAGATATGTATATTTGTCAATCATTCTACTGCGCCCTACTCTGTGAAG
AATAAGTTGAAGCCAGGCCAAATGGAGATGCTAAAGCTGACCATGAACAAACGGTACAA
TGTCTCCCAGCAAGCTCTTGATCTCCAGAATCTCCGCTTTGACCCAGACTTGATGGGCC
GTGACATTGATATAATCCTGAATCGAAGAAACTGCATGGCTGCCACCCTGAAGATCATT
GAAAGAAATTTCCCTGAGCTGTTGTCTTTGAACTTGTGCAACAACAAGCTGTACCAGCT
GGATGGCCTTTCTGACATTACAGAGAAGGCTCCCAAAGTCAAGACCCTGAATCTCTCCA
AAAATAAGCTGGAGTCGGCGTGGGAGTTGGGCAAGGTGAAAGGGCTGAAGCTCGAAGAG
CTATGGCTAGAAGGGAACCCGTTGTGCAGCACCTTCTCGGACCAGTCCGCCTATGTAAG
TGCCATCCGGGATTGTTTCCCCAAGTTGTTACGCCTGGACGGCCGAGAGTTATCCGCAC
CAGTGATTGTTGACATTGACAGCTCTGAGACAATGAAACCCTGCAAGGAAAACTTTACT
GGATCTGAGACCCTAAAGCATTTAGTCCTGCAATTCCTGCAGCAGTATTACTCGATCTA
TGACTCTGGAGATCGACAGGGTCTCCTCGGTGCTTACCACGATGAGGCCTGCTTCTCCT
TGGCTATTCCCTTCGACCCCAAGGACTCAGCCCCGAGCAGCTTGTGCAAGTACTTTGAG
GATAGCAGGAATATGAAAACACTCAAGGACCCCTACCTGAAGGGGGAACTGCTGAGGCG
CACAAAACGTGACATTGTGGACTCCCTCAGTGCGTTGCCCAAAACTCAGCATGACCTCA
GCTCCATCCTGGTGGACGTGTGGTGCCAGACGGAAAGGATGCTCTGCTTTTCTGTCAAT
GGGGTTTTCAAGGAAGTGGAAGGACAGTCTCAGGGTTCTGTTCTCGCCTTCACCCGGAC
CTTCATTGCTACCCCTGGCAGCAGTTCCAGTCTGTGCATCGTGAATGACGAGCTGTTTG
TGAGGGATGCCAGCCCCCAAGAGACTCAGAGTGCCTTCTCCATCCCAGTGTCCACACTC
TCCTCCAGCTCTGAGCCCTCCCTCTCCCAGGAGCAGCAGGAAATGGTGCAGGCTTTCTC
TGCCCAGTCTGGGATGAAACTGGAGTGGTCTCAGAAGTGCCTTCAGGACAATGAGTGGA
ACTACACTAGAGCTGGCCAGGCCTTCACTATGCTCCAGACCGAGGGCAAGATCCCCGCG
GAGGCCTTCAAGCAAATCTCCTAAaggagccctccgatgtcttctttgtcttcgttca
catcctctttgtttcctcttttcaccagcctaaggcctggctgaccaggaagccaacgt
taacttgcaggccacgtgacataaccacccaaagagccagttgctctgtgtattcgccc
cactcatgatcaccattttattttcataataaagagtgacgttacacgttaaaaa

Figure 53

SEQ ID NO.:53 hSPG3a encoded protein sequence

MRDVHKDQQLRHTPYSIRCERRMKWHSEDEIRITTWRNRKPPERKMSQNTQDGYTRNWI
KVTIPYGIKYDKAWLMNSIQSHCSDRFTPVDFHYVRNRACFFVQDASAASALKDVSYKI
YDDENQKICIFVNHSTAPYSVKNKLKPGQMEMLKLTMNKRYNVSQQALDLQNLRFDPDL
MGRDIDIILNRRNCMAATLKIIERNFPELLSLNLCNNKLYQLDGLSDITEKAPKVKTLN
LSKNKLESAWELGKVKGLKLEELWLEGNPLCSTFSDQSAYVSAIRDCFPKLLRLDGREL
SAPVIVDIDSSETMKPCKENFTGSETLKHLVLQFLQQYYSIYDSGDRQGLLGAYHDEAC
FSLAIPFDPKDSAPSSLCKYFEDSRNMKTLKDPYLKGELLRRTKRDIVDSLSALPKTQH
DLSSILVDVWCQTERMLCFSVNGVFKEVEGQSQGSVLAFTRTFIATPGSSSLCIVNDE
LFVRDASPQETQSAFSIPVSTLSSSSEPSLSQEQQEMVQAFSAQSGMKLEWSQKCLQDN
EWNYTRAGQAFTMLQTEGKIPAEAFKQIS

Figure 54a

SEQ ID NO.:54 hSPG3a genomic DNA sequence

AAAGGTGGGAGTTCTTTCCGGGATAATTTTGACAAGAGGAGCTGTCATTATGAACATGG
TGGGTATGAGCGCCCGCCTTCACACTGCCAGGAGAATGATGGAAGCGTGGAGATGAGGG
ATGTCCACAAGGACCAACAACTAAGACAGTAAGTGACCAGGCAGCCTGGTTTGCACGTA
GCAGCCCCCGGGACTGTGCAACCCTTTCATTCTCTGTGGTCTTCCTTTTCTTCTCTCAT
TAGAGAACTGACGAATGCTGGAAGTGGAATAGTGGCTGAGCAATCCTAATTGTAGCCCT
GGCGTCAGTGAGTGGAGCATGTATAGGAGACTTTCTTAGATTTAATGGATACCCGCCTT
CTCTCCTCTTCCCCACAGCACTCCTTATAGCATCCGATGCGAAAGAAGAATGAAATGGC
ATAGTGAAGACGAAATCCGTATTACCACGTGGAGAAATAGAAAACCTCCGGAGAGAAAA

Figure 54b

ATGAGTCAGAACACACAGGATGGATACACAAGGAACTGGTTTAAGGTCACAGTGAGTAT
CTTGGTGGGGTCTGCATTAGGTGGACTATTCTGGAACCTGATAGAAGGAAGACCACTTA
AAACACCCTAAGTTGATTATTTGGAGGAGAGCTTCGGAATGGGGGGAAAGGGAGTTTAG
GGCATCTATATTTGGCACAAAAATAAGAAATCATGTCAGCGGTCCTTTCTTTAGAAATC
TAAGCTAAGTAGAAGGTTGGAAAGAAAGAAAAAAAAAACCCAGCTGGTTGGTTCTGTTC
TCCATCCTTAGTTCCACGTTGTCTCTCCCTTCCCTCCTATTTCTTCTTTTTACCCTTAG
ATTCCTTACGGGATAAAGTATGACAAGGCATGGCTAATGAATTCAATCCAGAGCCATTG
CAGTGACCGCTTCACTCCGGTTGATGTAAGAGAGGATGGTGAAGCCAGATGAGTGGGCA
TGGGGGACGGGGAGAGGCCTGGCTCAGCAGGGGCCATTGGCCTCTGACGCTGTTGCTCT
TGCCTTCACTCCCTGTAGTTCCACTACGTCCGAAATCGGGCATGCTTCTTTGTCCAGGA
TGCTAGCGCTGCCTCCGCATTGAAGGATGTCAGTTATAAGATTTATGATGATGAGAACC
AAAAGGTGTGTGCCGAGGGCATGCCCTGTACTTAGTCTCTGGGCAGGAGGACAGGCCAG
GGGGCTGGTCATCCTCTTTGGGATTAGAGGTCCTGGTACTTACCACCCTGCCTTCCTGC
AGATATGTATATTTGTCAATCATTCTACTGCGCCCTACTCTGTGAAGAATAAGTTGAAG
CCAGGCCAAATGGAGATGCTAAAGGTAATACAGACTCAAGGATCATTGTATGTCCACTT
CCTGGACCCACCTCTTCTTCCCCTGGCCCCCTCTTTCCCTGTCACCACACCACCACCAC
CACCACCATCACCAGAGCCCCAGAGCCTCTGTCTTCATCTCTATCTCTGCAGCTGACCA
TGAACAAACGGTACAATGTCTCCCAGCAAGCTCTTGATCTCCAGAATCTCCGCTTTGAC
CCAGGTAAGGCTGACAGCAGCAATTCTAAGACAAGCGGGGGCAGAGAGGTCTGCCTGGG
AGGGAGACTTAGGAATGGCAATTTACAGAGGGGTTGGGGCTGGCTCTGGTCCAGCCAGG
GCCCTCCCAGCCTTCCGATTCCCTTCTCTTGGCTTCTTCAAGACTTGATGGGCCGTGAC
ATTGATATAATCCTGAATCGAAGAAACTGCATGGCTGCCACCCTGAAGATCATTGAAAG
AAATTTCCCTGAGGTGAAGCCTTAGGCTCAGTGCTGGTATTTAGTTAGAGGGGTGGAAG
GGATAAGGTGGAGGGCAGATTTGTCTCTGAGGCCCAAGATAGTAGCCGCCACTCTAACT
CTTCTTGACCCAAAGCTGTTGTCTTTGAACTTGTGCAACAACAAGCTGTACCAGCTGGA
TGGCCTTTCTGACATTACAGAGAAGGCTCCCAAAGTCAAGACCCTGAATCTCTCCAAAA
ATAAGGTGAGAAGGGGGAGCCAGATCAACTTTGGGTGGAGGGCAGGACACATCAGGATA
ATGGCAACAGCCAGGCAGTGGCACCTGTGGGTGACTATGAGGGCCGGGGGAATTCAGGG
CCCAGGGTCCTGGGTGTCTCTCTTTCCCTGGCCCTCCTTCTCCAGTTTCCTCCCCATCT
TTCTTAGCTGGAGTCGGCGTGGGAGTTGGGCAAGGTGAAAGGGCTGAAGCTCGAAGAGC
TATGGCTAGAAGGGAACCCGTTGTGCAGCACCTTCTCGGACCAGTCCGCCTATGTAAGG
TCAGTGGCAACCCCGGTCACCCTTCCTGGGCACCTTTGCTCCCTGGGTGACTGAGCTGT
GTCTGAAGGTGCCCTTCTGCAGGAAGAAGCAGCCTTGGTCCTCTGGAGGACCACAGAC
CTCCCTTCCTACTCTCTCTCTCTCTCTCTCTCTCCTCTCTCTCTGTCACTCACTCATCT
GTGCTTAGAGGTCTCCTTTCCTTCCTCTGACATGGTCCCCTTTTCACCTGCTCTGGGGT
GTGTTTCCCGCCTGTCTCCACCAAGCCTCCTCCAGTGTGCCCTCTGTGAGTGTGCTCCA
GGAAGTGGGGCTCCCCCACCTCCCCAGGACCAGCAGTATTCAGATGCTGGTGCCCTGGA
CCGAGAAGAGTCCTTTAGTCCGGGGCTTCATGCTGAGACAGGCCTTCCTGCCTCCATGC
TGCGATGGGGCTTCCCTCCCCTGTCCCAAGAGGGGTTCTCCTTCTCTTGCTCCAAAAAG
GTCCCCCCACCTGTCCTGGGCTGGCATGGGGGCTTCCCTGCCCCATACTGAGGGCTGGG
GCCCCGGGTGGCTGCTGTCATGCCATCTCTTCCTCTGGCCCAATGCCAGGAGCTGGGCC
CTCCTTGGGGAGAAACCTGGGTTTCCTACGTCAAGGGGCCAGAAGCGGGCCACGTTCCT
GAGGCAGGAGTGGAAGGCAGAGGGCAGAGGAGGTTGAGAAGACAGAAGGACAGGCCTCT
CAGGCACTGCCCCACCTTCCCTCCTTCTCCACCTCACATCGTCCTGCCTGGGCCCTCAG
AGGAGCCCTGGGTAGCCCGAGATGGGTAGCATTCCTCGGTCAAGGCGTCAGCACAGAGG
GGCACAGGAGTCAGGGACCATCAGAAGAGAATGCAGTGGTCTGGAGAGGGGGTCCCCAG
ACTCTGAACCCCATGCTGAGCTGGGGCCTGACTCTTCACTCCTCCCGGGAGAAGGTCTC
CTGTCCCCGTGGCTGCTCTGTTTCCCATGCCCAGCTCAGACTGAGCTCACACAGGTGAG

Figure 54c

GAAGGCTCCAGCTGCATCCAGTGGGCCCCAGCCCAACAGGCGCATGTTTTCCTTTCCTG
CCTCGGTCCCCAGGGCCAGCCAGGGAGCAGTGAGGGAAAGGGCTGCAGCAGGGGAGCCC
TTTTCTCCTCTTCTCCTCCCTGAACTCCACCTCCGCAGTAGAGAGTCTTTCCCTTCCCT
TTGCATTGCATCCTGTTTCTCCCTTGTCTCTCCTCTCCTATGTCTCACCCATCCGTCCC
TCCCCTACCTTCACCCCGTTTCTGTTGTTGTCCCCCCTGCCTTCCGCTTCCTGCCTCCT
GAGTCCGGCCTCACTCACCTCCGTGTCCCAGCATCCTGGGCCATCCCTAAGGGCTGACC
TGGTCTTGGCCAGGGCCTGGTCAGGCAGGTTGATGGACAGCCAGTGAGGTGGCAGAGCC
CTGGGCTCCCACCCCATTTCCTGCTCCCTGCAGAGCCTTCCATGGTGACTTGGGCAAAG
GGGAGGGAGGGAGAGGAAGAAAGCCCTGGAGCCTGGGCTCCCAGTGCTGCTTCTTGTAG
CACTGGAGAAAAGGGAGTCAGGACAGTCTAGATGGAAGCTAACCAGGAGGAAGGAGAGG
GAGGAGTGTGAGAGGGAGTGGGAGAGAGACTGTGCAACCCTGAACTGTCAGTCACTTCA
TTCAATTTTTGGTTTTGGACAGTGCCATCCGGGATTGTTTCCCCAAGTTGTTACGCCTG
GTAAGTATGTATAATACCGTCATCATTGTCTCCTCTTACTCAAGAAAAGGACCTCCACG
CCTGCCCTCAAGTCCTTTGGGTCTTGCCTAGATTACATGCTTGTATCAGACCCTCATCC
ATTTTACAGGCATGGATTCCTGAAAAAGACAAGAATATTCTCCCTGGAAAATGTGTCCC
CCCGCCGCCACCCCCCCCCCACACACACATTTGCATGTGATAGTAGAGATGTCCAGCAC
CCCATGAGAAAGCCACCCACTGGAATTTCCAGGGCCATTTCCCACCTAGCCTCTGATGC
TTGTCTCCCTGGGCATGTTCATCTTATCGATCATCCAGCTCCATCTCCTTGGTCTCCAC
TGCTGACTTCCTCTTTCCTTCTCCAGGACGGCCGAGAGTTATCCGCACCAGTGATTGTT
GACATTGACAGCTCTGAGACAATGAAACCCTGCAAGGTGAGGAAGAAGGACCAAGCAAG
ATTTGGGTTGCTGTAAGGGAGGCTTTGTCCACCGCATAGATCCAAATTGTCTTTTGATT
TCAGGAAAACTTTACTGGATCTGAGACCCTAAAGCATTTAGTCCTGCAATTCCTGCAGC
AGTGAGTATCCCTGGGACCATGAGGAAGGGGAGGGCTGAGACAGGCTGGGCCACCCGTG
CAGCCTGGGAGTTTTCAAGTCTCATCTGGGGCCCAGGCCACAGAGATAGCCTATCCTCA
CTGCTTCCCCACAGGTATTACTCGATCTATGACTCTGGAGATCGACAGGGTCTCCTCGG
TGCTTACCACGATGAGGCCTGCTTCTCCTTGGCTATTCCCTTCGACCCCAAGGACTCAG
CCCCGTGAGTATCACGGCTCAGACCCTGCTCTGGGGCTGTGTGTCTCCCCAGCAGACAC
AGGCCAACTCCTGGAAATGCCCACACTGGCCGGACCACCCACTCCTGCTCCTCTTTTTC
TCCTAGGAGCAGCTTGTGCAAGTACTTTGAGGATAGCAGGAATATGAAAACACTCAAGG
ACCCCTGTAAGTGTGTGATGGGGAAGAGTGGGCAAGGTAAGGGGGTGTGATGGGAACAA
TCACAGGGGCCAAGGACCAGGATGTGGTAGCCCCCCGCCCTGCCCCGCCCACCCTGCCA
TTCCTTGCTTCTCCTCTCCTCTACAGACCTGAAGGGGGAACTGCTGAGGCGCACAAAAC
GTGACATTGTGGACTCCCTCAGTGCGTTGCCCAAAACTCAGCATGACCTCAGCTCCATC
CTGGTGGACGTGTGGTGCCAGACGGTGAGCACCTGCTTCCTCCCTTGGGCAGGCCCAGA
GAGCCAGAGGTGGGTAGGAGGTTAAGGAGGATCCTGAGCACCTGAGCGCTTCCTTTTCA
GGAAAGGATGCTCTGCTTTTCTGTCAATGGGGTTTTCAAGGAAGGTGAGTGTCTGTATA
GTCCCCTCCCCAGATCCCCCACTGCTCCCTCCCCCTGGCTGGGCTCCCTCTCAGAACTC
CCCCAGCTTCCCTGCTTTCGTTCCTTTCCTTTCCTTCCTCTTCTTTCTTCCGTGTTTTC
CCACCCCCACTCTGCCTTCAAACCACCCTGATCTGACCTAGGTCCATGCCTGTCTGCCC
TGCACAGCTCAGGCGTGCGTTAAGGACACAGACTGTGGAGTTTGACAGCTCTCATCCCA
GGTCCTTACTCTGTGAACTTGTGCTGGTTACTTAACCCTTCAGTTTCCTCATTTGCAAA
ATGGGGCTAATAATCTATCTCTTGGGCTACTGTGAAATAGGAATTAAGTGAACTTGTGG
TTTTCCCAGGGCCCCACACATGATAGGGGCCCTGTCACTGGAGCGGATTGTTCCTGTT
GCTGCCCTCCCCATTCCTGCCACATCCGCCTGACTCCAAGTGAACAATTGTCCTGGTCT
GCCCCCTCCCCCCCTTCTGTGTGAGTGTCAAGCAATACTCTGACTGGGGATCACCGTGT
GAGCATGTTAAAGCCTGTGCAACTCTAAGGTGGTGGTGTTTGTTGTCTTTGAAGTGGAA
GGACAGTCTCAGGGTTCTGTTCTCGCCTTCACCCGGACCTTCATTGCTACCCCTGGCAG
CAGTTCCAGGTTAGTGCTGTGTTGTGGGTGGGAGCACCCATCCAAGCTTGGGGCCAGTG

Figure 54d

TTGTGGAAATGTGGTGGGTGCAGTCCTCCGGGTGTTCTCAATATTGTGGAAGGCCGACA
GGAAGATCCAAGGAGCAGTCTAGCCTAGTGTTTAAGAGTGTGGGCCCTGGAGTCAGAAT
ACAGATTCTGTTCCTCACTCCAACACTCACAAACTGTGTGACCTTGATCAACTTATTCG
ACCACTCTGTGATTCAGTGCCTTTTTCTGAAAATTGGAATAAGACTATCCACTTCCTTG
GGCTGTTGTACAGGGTAAATGCGTTGGGGTTGGATCTAAAAATCTAGTGAAGCTGGTAG
ACAGTCCCTCCAAAGGTGGACTCTGTGGGAGGGTTAGAGGGTACCAGCCAAAAAATCTG
GGAGGCAGGCACAGTTAGGGATATGGAAGGAATTTGGTTGTTGAGTGGCAGTGGTTAAG
AAGGATCCTGTTGTTGGGGGTGCGGAGTTATCTACTTGTCCAGTTTGAGGGTGCATTTT
TCTTTCCTCCAGTCTGTGCATCGTGAATGACGAGCTGTTTGTGAGGGATGCCAGCCCCC
AAGAGACTCAGAGTGCCTTCTCCATCCCAGTGTCCACACTCTCCTCCAGCTCTGAGCCC
TCCCTCTCCCAGGAGCAGCAGGAAATGGTGCAGGCTTTCTCTGCCCAGTCTGGGATGAA
ACTGGAGTGGTCTCAGAAGTGAGTGCTGGGAGTACATGGGGATGGGGGCTGTTGGGACA
TCAGAGGAATGAGTAATGGAAACTCACATGCAATTTGGAAAAATAACTATCTGGGTATT
TTGCTTCCAAAAAAAGTGGGTCCATGAAAAAGGTATCATACTTTTATACTGGTATATGT
AAATATTTTTTTAAATGGCATAATGCCCAAATGACATTACCTTCCATTTGTAAAATCTG
AAAGAATCAACCACAATAAACTACTGATAAACCAGGTCAGCAAGGTTGAAAGATACAAT
ATACAAAAATCATTTGTACTTCTATGTAGTTGCAATGGACAATCCAAAAAAATGAAATT
AAGAAAATAAGTCCATCTACAGTAGCATCGAAAAGAAGAAAGTATGTAGGAACAAAATT
AAGAGAAGAAGCGCAAATCTTGTACTCTGAAATCTGCAAAACATTGCTGAAAAAAATTA
AAGAAGACCTAAATACGTGGAAAGGCATCCCACGTTCATAGATTGGAAGACTTAATATC
ATTACGATGGCAGTACCACCCAGAACAATCTACAGATTCATTGCAGTCCCTGACAGAAT
CCCAACTGACTTCTTTGCAGAAATTGACAAGGTAATCCCAAAATTCATGTGGAAATGCA
GTGGACCCCAAACAGCCAAAACCATCTTGAAAGAGAAGAACAACGTTAGAAGACTCACA
CTTCCCGATTTCAGAACTTGCTACAAAACTACATTAATCAAGACTGTATGGTACCGACA
TAGGAACAGACGTGGGAATCAATGGAATATAATTGAGAGTCCACAGATAATCTCACGTA
TTTATGTCCAGTTGATTATCATTCAGGGTGCTGAAAAAATCCAATGGAGAAAAAAAATA
GTCTTCTTAACAAATGGTGCTGGGAGAAGTGGATATCCACTTGCAAAACAATTAATTTT
GACCCCTAACTCACATCACGTGCAAACACTGGCAGAAAATGGATCAATGACCTAAAATA
AGAGCCAGAACTGTAAAACACTGTAAGTGTACATCTTCATTACCTTGAATTAGGCAACC
ATTTCTTACATATGAAACCAAAAGCACAAGCAACCAAAGAAAAAATAGGTAAATTGGAC
TTCATCTAAATTAAAAGCTTTTGTGCATCAGCAGACACTATCAAGAAAGCGGAAAACCG
ACTGGTGGGAACAAGGGAAAATATTTGCAAATCACATCGCCGACAAGAAGAACCCTTAC
AACTCAACAACAAACAGACAAGCCACCGAATTAAAAAATGGGAAATGATTTGAATAGA
TGTTTCTCCAAAGGAGATATACAAATGACCAAGAAGCACGTGAAAATCTTCTCAACATC
GTTAGTCATTAGGGAAACGCATATCGAAACCACAGTGAGTTACCACTTCATACCCACTA
CGCTAGCTTTAGTCCATAAAAGGAAACATGACAAATGTCGGTGAGAATGCAGAGAAATT
GGAAATCTCATGTATTACTACTGGGAACATAAAGTGGAGCAGTTGCTGGCAAAAAGATT
TTGGCAGTTCCTCAAAATCTTAAACATGGAGTTACCACATGATCCAGTAATCCCACTCC
TAAGTGTATACCAAAAGAAATGAAAATATATGCCCATTCAACAACTTGCACATGAATTT
CCGTAGTGGCATTATTCCAAATAGCCAAAAAATGGAAACACATGGATTGACCTTCAGCT
GATGAATGGATAATGTGGTACATCCATACGGTGGAATATTATTAGAATATTATTCATCC
ACAAAAAAGGATGTAGTTGTGATATATGCTATGACGTGGATGAACCCTGAAAACATTAT
GTGCTAAGTGGGAGCACCCAGTCACAAAAAGCCACATAATTATATGATTCCATTCATAC
GAAGTGTTCAGAATAGCCAGATCCGTAGAGACCGAAAGCAGAGTAGTGGTTGCCAAGAT
CTGGGGAAGAGGGAGAACAGGGAGTGATCTCTAACAGTTAAGGAGTTTCTTTTTGAGGT
GATAAAAACAGTTTGGAATTAGATAGGTGTGATGGTTGCACAATCTTGTGAATAGACTT
AAAAGCACTGAATTGTACACCTTAAAATGGTGACTGCTACAGTATGTGCATTATATCTC
AATAGAAAAGAAACGTATTATTGAATTTCCACTTGTTATTTCTTGAACATCTTTCTTTA

Figure 54e

TCAATATGTATTAAGCTCCCTTGTTCATTTGAATACCGCTATGTTTCTGATTTGAATTC
TAGTGGGCATTAATGTCAGGGATGGCGTTTTGGTTTTCCCCAGGCCTTTTTTCATTGT
TACAATAGTGCTCATATTGGTACATGTGACCCAGCAAAAAGGTAGCATAGATTAAGGGT
GGCATTGCATAGTCAGCGTGTCTGTCCTGGGCTAGTAATGGAGAGCACCTGTTCTTCTC
CCACCCCAGGTGCCTTCAGGACAATGAGTGGAACTACACTAGAGCTGGCCAGGCCTTCA
CTATGCTCCAGGTGAGGTCTGGGAATCAAGTGGGTAAAAGACAGCTGTCTCTGGGTCGT
CAGGAGGGCCAAGAAGATGGAGGCCAGGTAGTGTGGGGATGGAACCCAGTGCACCTGGC
TCTACTAACATCCCAACTCCTTTTCTTTACTTTCTCTAGACCGAGGGCAAGATCCCCGC
AGAGGCCTTCAAGCAAATCTCCTAAAAGGAGCCCTCCGATGTCTTCTTTGTCTTCGTTC
ACATCCTCTTTGTTTCCTCTTTTCACCAGCCTAAGGCCTGGCTGACCAGGAAGCCAACG
TTAACTTGCAGGCCACGTGACATAACCACCCAAAGAGCCAGTTGCTCTGTGTATTCGCC
CCACTCATGATCACCATTTTATTTTCATAATAAAGAGTGACGTTACACGTT

SEQ ID NO.:55 hSPG3b cDNA sequence Figure 55

CCAGCACGAAGGAGACCCAGAGTGCCTTCTCCATCCCAGTGCCTGCACCCTCCTCCAGC
TCCTTGCCTACCCTCTCCCAGAAGCAGCAGGAAATGGTGGAGACTGTCTCCACCCAGTC
TGGGATGAAACTTGAGCAGTCTCAGAAGTGCCTTCAGGACAGTGAGTAGAACTACACCA
AAGCTGACCAGGTTTTCACTATTCTCCAGACCGAAGGCAAGATCTCAGTGGAGGCCTTC
AAGCAAATCCCCTAAAAGGAGCCCTTCGATGTCTTCTTTGTCTTCATTCACATCCTCTT
TGTTTCCTCTTTTTACCAGCCTAAGGCCGTGCCCAGGACTGGGGTTGGCAGCCTGGCTC
ACCGGAAAGCCAAAGTTAACTTGCAGGCCGGGTAACATAACC

SEQ ID NO.:56 hSPG5 cDNA sequence Figure 56a

ATGCCCAGTGATGCCAAAGACAGTGTTAATGGTGACCTTTTGTTAAATTGGACAAGTCT
TAAAAATATTTTAAGTGGTCTTAATGCTTCTTTTCCTCTTCACAACAATACTGGCTCAA
GCACAGTCACTACTTCAAAATCCATCAAAGACCCAAGACTGATGAGGAGAGAAGAAAGT
ATGGGAGAACAGAGTAGTACTGCAGGCTTAAATGAGGTTTTGCAATTTGAGAAGAGTTC
AGATAATGTTAATTCAGAAATAAAATCGACACCATCTAATTCTGCCTCCTCCTCAGAAG
TTGTCCCTGGTGATCGTGCTGTTCTTACTAATGGTTTGGATACCCCTTGCTTTAAAACT
TCTGTTAATGATTCACAATCTTGGGCTCACAACATGGGCTCTGAGGACTATGACTGTAT
ACCTCCCAATAAAGTTACCATGGCAGGGCAATGTAAGGACCAAGGTAATTTTTCCTTCC
CAATTTCTGTGTCAAATGTAGTGTCAGAGGTTGAGAACCAAAACCACAGTGAGGAGAAG
GCTCAGAGAGCCCAACAGGAGTCCGGTAATGCTTATACAAAAGAGTACAGTAGTCACAT
TTTTCAGGACTCGCAGTCTTCTGATTTAAAAACAATTTATCAGACTGGTTGCCAAACGT
CTACAGTTTTTCCACTCAAAAAGAAAGTAAGCATTGATGAATACCTTCAAAATACTGGA
AAGATGAAAAACTTCGCTGACCTGGAAGACAGTTCCAAACATGAAGAAAAGCAAACTTC
ATGGAAAGAAATTGATAATGATTTCACTAATGAAACAAAAATCAGTCCAATAGATAATT
ACATTGTTTTGCACCAAGAATACAAAGAGAGTGAGAGTCATAATTCTTTTGGGAAAAGC
TGTGATAAAATATTAATTACTCAAGAGTTAGAAATAACAAAATCTTCTACATCTACCAT
AAAGGATAAGGATGAACTAGATCATCTAGCATTGGAATGGCAAATTACTCCAAGTTTTG
AGAGCCTGTCACAAAAGCATCCTCAGCACTCTGTGGAGTATGAGGGTAACATTCATACA
AGTTTAGCCATTGCTCAAAAGCTAATGGAACTGAAATTGGGGAAAATAAATCAAAATTA
TGCTAGCATTATAACTGAAGCTTTCCCGAAACCAAAAGACATACCCCAGGCCAAAGAAA
TGTTCATTGATACAGTTATTTCATCTTATAACATAGAAACAGCTCATGACAGTTCAAAT
TGCAGCATAACTAGAGAACATATATGTGTCCATAGGAAAAATGAAAATGAACCAGTGTC
ATTAGAGAACATTCAGAGAGACTATAAAGAAACTGCTTATGTTGAAGATAGGGGTCAGG
ATCACAATCTGTTCTGTAATTCACAGTTAAGCAATGATATATGGCTGAATGTTAATTTC
AAAAAACAAACAGATAGAGAAAACCAAAATGAGGCTAAAGAGAATAGTGCTTCATGTGT

Figure 56b

AGAAAACAACATAGAGAACATATATGGAGACAAAAAGCAGGATTCTCATACAAACGAAA
ATTTCAGCAATATAGATGAAAAGGAGGACAAAAATTACCACAATATAGAAATTTTGAGT
TCTGAAGAATTTTCTACTAAATTTAACTTGATTTGCAGAGAAGATAATGCAGTGTCAGC
AGCAACTGCATTATTAGAGAGTGAAGAAGATACCATTAGTGCCGTGAAACAAAAAGATA
CTGAAAATACTGGAAGAAGTGTAGAGCATTTGGCTTCCACGACATTTCCCAAAACTGCA
AGTTCTTCAGTGTGTGTAGCCTCAAATGCTGCAATACAGATAGCTAGTGCTACTATGCC
TGCATTAAGCCTAAATAATGACGATCACCAGATATACCAGTTTAAAGAAACTTGTTCTT
CTGAAAGTCCAGATTTTGGTTTGTTAGTAAAACATAGGGTTTCTGATTGTGAAATTGAT
ACGGATAAAAATAAATCACAAGAATCATTTCATCAATCAATAAATGAGAACTTAGTTCT
TCAGAGCATTGAATTGGAAAGTGAAATTGAAATAGAATTAGAAGATTGTGATGATGCTT
TTATATTTCAACAAGATACACATAGCCATGAAAACATGCTTTGTGAAGAATTTGTGACC
TCATATAAGGCTCTGAAGTCTCGTATCAGTTGGGAAGGTCTGTTAGCACTTGATAACGG
GGAGATGGAAGTTTTGGAAAGCACCACAGGAAGGGAGAATAGTGATCAGCATTATTCTA
AGGAAAGTAACTATTTTTATTCCTCTACACAAAACAATGAAACAGAACTTACCAGCCCA
ATTTTACTTCCAGATCTACAAATTAAAATTACTAATATATTTAGGCCAGGATTCAGCCC
GACAGCTGACTCCCTTGCATTGAAAGATAGTTTTTGCACACATGTAACTGAAGCCACAA
AACCGGAAATAAATAAGGAAGATGGAGAAATTCTAGGATTTGACATTTATTCCCAGCCT
TTTGGTGAAAATGCAGATTATCCATGTGAAGATAAAGTTGATAATATAAGGCAAGAATC
AGGGCCAGTGAGTAACTCTGAAATCTCCCTTTCTTTTGACTTGAGTCGTAATACAGATG
TGAATCATACGTCTGAAAATCAGAACAGTGAATCTTTGTTTACTGAACCTTCTAATGTC
ACAACAATAGATGATGGAAGCAGATGTTTCTTTACAAAATCAAAAACTGACTATAATGA
TACCAAAAAATAAAAAGGAGGTAGAATCAAGAATTAGCAAAAGGAAGCTACATATATCTT
CCAGGGATCAGAACATACCACATAAAGATTTAAGACGACATAAAATTTATGGGAGAAAG
AGGAGGCTAACCAGTCAAGACTCATCTGAGTGTTTCTCTTCATTATCCCAAGGACGAAT
TAAAACATTTTCACAGTCAGAAAAGCACATTAAGAGTGTCCTAAATATCCTAAGTGATG
AAGCATCTTTATGTAAAAGCAAATGTCTTTCCAGAAAACTAGACAAAGCAGTTGTTCAC
TTAAAAAAAGCTCATAGAAGAGTTCACACATCTTTGCAGCTTATAACTAAAGTAGGAGA
AGAAAGAAAGGGCCCATTACCAAAATCATATGCAGTAATATGCAATAATTTCTGGGAAA
GTTGTGACCTTCAAGGTTATAGTTCTGTGTCTCAAAGAAAATATTATTCTACTAAGCAT
TTTTCGTCAAAAAGAAAATATGACAAACGGAGAAAGAAAAGAGCTCCAAAAGCTGATAT
TTCTAAATCATTAACCCATGTGTCAAAGCACAAGTCTTATAAAACAAGTGGAGAGAAAA
AATGCCTTTCTAGGAAAAGTATGGCTAGCAGTGTCTCAAAAAGTCACCCCACCACCAGT
CACATGGGAGAATTTTGTAATCAAGAACATCCTGAATCACAGTTGCCTGTATCCTCCAC
ATCCCAAAGTACAAGTCAGTCAGTTTATTATAATAGCAGTGTAAGCAATCCAAGTTTAT
CAGAAGAACATCAGCCCTTTTCTGGAAAAACTGCATATCTGTTTTCCCCAGACCACTCA
GATGAGAAACTAATAGAAAAAGAAAATCAAATTGATACAGCATTTTTATCTAGCACTAG
TAAATATGAAAAGCTTGAAAAACATTCAGCAAATCATAATGTTAAAGATGCAACTAAAG
AAAACAGTTGTGACGCTAATGAAGTAATAAATGAAAGTAATTCTGTATCTTTAAGTTGC
ATAAAAGAAAACATAAATTCTAGTACAGGCAACGATTGTGATGCAACTTGCATAGGTCA
CACAAAGGCGAAAACTGACGTACTTATATCAGTCTTAGATTCAAATGTGAAGCACTTTT
TAAATGATCTCTACCAACAAGGTAACCTTATTTTATCTGATTGTAAAAGAAACCTGGAA
GTAAAGTGGACAGATCCTATTGAGAGACCCAAACAAAGCATTATTACAGGAAACTTCCT
TATGGGCCCATTAAACCTAACTTTGATAGCAAGTAAAAAGTACAGTATTCCTCAGGTAT
CAGCCGCTGCAGTGACAGATAGTGAGGGAGAATCTTCAAAATCTTACTTGGATAAGCAG
AGAATTCTTACTGTAGATTCTTTTGCAGCATCCAGTACTGTACCACACTGTGAGCAGAG
CTGTAGAGAAAAAGAGCTTCTAAAGACAGAACAGTGCTCTTCAGGTAATTGCCTCCATA
CAGATGGGAATGAAACAAATGTCACTGAGAATTATGAGTTGGATGTAGCATCAGGAACT
GAAGAAGATAAAAGTTATGGGGAAAATATAGTGGAATTATCTTCCAGTGATAGTTCTCT

Figure 56c

GCTTTTAAGAGATAATGTAAAAGGCTCCTCTTCAGAAACATGTATTGTGAAGAAAGACA
CTGAGGACAGAATAACGTGGAAAGTTAAACAAGCGGAAAAAGCAAAAGATTCTGTTTAC
AAAAGAAGCATGACTGAAGGATCAACTGTTAATACTGAGTACAAAAATCAAAAGAATCA
GATCTCAGAAGAATCCTGCTTAAATGAGAAAATTATTACAACTAACTTGATTGATTCCC
ATCTGAGCACTAAAAATACTACCACTGAGTCAGTCCCTTTGAAGAACACAGTTTCTAAT
CCGCTTAACAAAAGAGAGAAGAAGGGGGAAATTAAAGTTAGTAAAGACTCGCAGTCTGA
CTTGACATTACATTCAGAAATAGCCTATATTTCCAAACCAGGAATTCTAGGAGTTAATC
ATACGCCTATTTTACCTGCCCACTCTGAAACCTGTAAAGTCCCTACTCTTCTGAAGAAA
CCTGCGTCATACGTGAGTGATTTTAAAGAAAAACATTGCTCAGCTAATCATACGGCCCT
TATAGCTAATCTATCTCAAATTTTGCAGAGGGCAGATGAAGCATCATCTTTGCAGATTC
TACAGGAAGAAACTAAGGTTTGTCTAAATATTCTCCCTTTATTTGTGGAAGCTTTTGAA
AGAAAGCAAGAATGTTCAGTTGAACAAATCCTGATTTCAAGAGAACTGTTGGTAGACCA
AAACCTGTGGAATAATTGCAAACACACATTAAAACCATGTGCTGTTGACACTTTGGTAG
AACTTCAAATGATGATGGAAACAATTCAATTCATTGAAAACAAAAAAAGGCACTTAGAA
GGTGAACCAACATTGCGAAGCTTGCTTTGGTATGATGAAACACTGTATGCTGAGCTTCT
TGGAAAACCACGTGGATTTCAACAGCAGTCTAATTTCTATCCTGGTTTCCAAGGAAGAT
TAAAATATAATGCATTCTGTGAGTTACAGACTTACCATGATCAATTAGTTGAATTGCTT
GAAGAAACAAAAAGGGAAAAGAATTCATACTATGTATTCTTAAAGTACAAACGACAGGT
TAATGAATGTGAAGCCATAATGGAGCATTGTTCCGATTGCTTTGATTTTTCTCTTTCTG
TTCCATTTACCTGTGGAGTTAACTTTGGAGATAGTTTAGAAGACCTGGAAATCTTAAGA
AAAAGTACTTTAAAGTTGATCAATGTATGTGGGGACTCTCCTAAAGTTCATTCGTATCC
AGGAAAACAGGACCATCTGTGGATTATCATAGAAATGATCTCCTCAAAGGTTAATTTTA
TTAAGAACAACGAGGCAGTACGTGTTAAAATATCTCTTTATGGTCTGGAACATATCTTT
TTTGATGCTGCAAAAAATCTTGTTTGGAAAGAGAGAACACAATCCTTCAGCAAAAAATA
CTCACAAAAGAAGGACGAAGAAAGGCTACTCAGAGTGAATAAATGTGCCTTTTCTAAGT
TGCAGAAGATATATGATACTTTGTCTAAAGATTTAAACAATGAACCAATTTCCCCTATT
GGGCTTGAGGAGGATACTATAATTGCTTCCAGAAAGTCAGATCATCCAATAAACGAAGC
AACAATTAGCATAGAAAATTCTAAATTTAACAGTAATTTGCTTGCACACCCAGATATTT
GTTGTATTAGTGAGATATTGGATCAGGCTGAATTTGCAGACCTTAAAAAATTACAGGAT
CTCACCTTGAGATGTACAGATCACTTAGAAATTTTAAAAAAATACTTTCAGATGCTACA
AGATAATAACATGGATAATATTTTTATCACAGAAGAAAATGTTTTAGACGTGGTGATAA
ACCACAGCCATGAGGCTATCATTTTAAAGCCTGAAGCTATTGAAATGTATATTGAAATC
GTCATGGTCTCAGAAACAATTCACTTTCTTAAAAACTCAATAGCAAAGAAACTAGACAA
ACAGAGGTTTCGAGGTATGCTTTGGTTTGATTTGTCACTTCTTCCTGAGCTGGTTCAGT
GCCAAGAAAAAAATGGCTTCTTTTTCATTTCTTAAAGATAACTCAACAGATGTTTGCCTT
TGGAAAGTGATAGAGACTGCTGTTTCCGAACTTAAGAAAGATCTGGATATTATCTGCAA
ATATAATGAAGCTGTTAATTGCTCATATGCTATTCATTTGCTCTCAAGAGAACTTCAAG
AACTTTCAGAAATAAAAAAGCTTCTGAAGAAGTCCAAGTATTTTATTTCCACATATATT
GACTTTGTGCCATATATAGCATCCATAAATTATGGAAGCACTGTGACAGAGTTAGAATA
CAACTACAATCAATTTTCTACACTGCTGAAGAATGTAATGTCTGCCCCTAGGAAAGATT
TAGGAAAAATGGCCCACATTAGGAAAGTCATGAAAACGATTGAACATATGAAGATGATA
TGTACTAAAAATGCTGAACTAACCATTTCCTTTTTCCTATGCCAAATGCTGTATAACAG
AAGGAAGATTTTACAGCTGAAGAGAAAAGAAAAAATGAATATTCATATTGTAAAACCTG
GGGAAAATAACAATAAATTTAGTATTTCTACGATGTTGCCCCCAGTATCAGAGTGCATA
AACAAAAACATCTCAAATTCCTCTAAAAAACGACCGAGCACTGTAGACAAATGTGAAGA
CTCTCAGGAACAACAGCAAGATACTACTGTTTCCAGTTGTAAAAAGCTAAGGTAGACA
TGAAAGATGTCACAAAAATCAACAGAGAAAAGGCAACATTCAAGCATCCAAGGACTACA
GGATCTCATCCCAAAAGCGAAAACAAAATAGTACCAAGTTCATGTGACAGTCTGAAAAG

Figure 56d

AAATCATTTAACGCCAAAAAAGGTTGAAATGCAAAGATCACTACCTGGCTCACTTTTAC
CCTTAGAGAACCCAAAAGACACTTGCGCATCAAAGTCGGAAAGCAAAATAGACTTAACT
GTTTCATCTGATCACTTCAGTGGACAACAGGAAAATTTAAATAGCATGAAGAAAAGAAA
TGTGAACTTCAGTGCTGCTGAAACAAAAAGTGATAAGAAAGATTGTGCTGCTTTTGCAA
TTTGTGACCAAAAAAGTGTACATGGCACATTTTCACCAGACCATGGACGCTTTTGCAG
AAATTTCTTAAAAATTCCCCAGATCCCACCCAAAAATCCTGCCTTTCTGATATAAACCC
AGAAACTGATGTTTCTCTTGTGCCTGATGCGTCGGTGCTCTCAAAGCCAATTTTCTGTT
TTGTGAAAGATGTCCATCCTGATCTAGAAATGAATGACACAGTCTTTGAACTTCAAGAT
AATGATATAGTAAATTCATCTATTAAAAATTCCTCATGCATGACTTCTCCAGAACCCAT
CTGTATCCAGAACAAAATTCCTACTCTGCAGATAAACAAACTACAGCCTACAGAAACTG
AGTCAGAGGACAAATACATGAAGGATACATTGAATCCCAATACTGTGCATACTTTTGGA
GCATCTGGGCATATAACCCTTAATGTGAATCAAGGAGCAGAGTACTCTCTTTCTGAACA
ACAGAATGACAAAAATTCAAAAGTCCTAATGCAGAATGCTGCCACATATTGGAATGAAC
TTCCACAGTCTGCATGTAACCCAACATATAATTCTTCTGAGCATTTATTTGGAACTTCA
TATCCATACTCTGCTTGGTGTGTTTATCAGTACAGCAACAGCAATGGCAATGCCATTAC
CCAGACATACCAAGGGATAACATCATATGAAGTACAGCCATCTCCTTCTGGGCTGTTGA
CCACAGTTGCAAGTACTGCCCAGGGCACACATTCTAATCTTCTGTACTCTCAATATTTT
ACTTATTTTGCGGGGGAGCCACAAGCAAATGGCTTTGTGCCAGTGAATGGGTATTTTCA
ATCTCAAATACCTGCTTCTAATTTTCGGCAGCCAATTTTTTCACAATATGCTTCTCATC
AGCCATTACCACAAGCTACATACCCTTACCTTCCTAATCGATTTGTGCCTCCAGAAGTT
CCTTGGGTTTATGCTCCATGGCACCAAGAATCCTTTCATCCAGGACACTGA

Figure 57a

SEQ ID NO.:57 hSPG5 encoded protein sequence

MPSDAKDSVNGDLLLNWTSLKNILSGLNASFPLHNNTGSSTVTTSKSIKDPRLMRREES
MGEQSSTAGLNEVLQFEKSSDNVNSEIKSTPSNSASSSEVVPGDRAVLTNGLDTPCFKT
SVNDSQSWAHNMGSEDYDCIPPNKVTMAGQCKDQGNFSFPISVSNVVSEVENQNHSEEK
AQRAQQESGNAYTKEYSSHIFQDSQSSDLKTIYQTGCQTSTVFPLKKKVSIDEYLQNTG
KMKNFADLEDSSKHEEKQTSWKEIDNDFTNETKISPIDNYIVLHQEYKESESHNSFGKS
CDKILITQELEITKSSTSTIKDKDELDHLALEWQITPSFESLSQKHPQHSVEYEGNIHT
SLAIAQKLMELKLGKINQNYASIITEAFPKPKDIPQAKEMFIDTVISSYNIETAHDSSN
CSITREHICVHRKNENEPVSLENIQRDYKETAYVEDRGQDHNLFCNSQLSNDIWLNVNF
KKQTDRENQNEAKENSASCVENNIENIYGDKKQDSHTNENFSNIDEKEDKNYHNIEILS
SEEFSTKFNLICREDNAVSAATALLESEEDTISAVKQKDTENTGRSVEHLASTTFPKTA
SSSVCVASNAAIQIASATMPALSLNNDDHQIYQFKETCSSESPDFGLLVKHRVSDCEID
TDKNKSQESFHQSINENLVLQSIELESEIEIELEDCDDAFIFQQDTHSHENMLCEEFVT
SYKALKSRISWEGLLALDNGEMEVLESTTGRENSDQHYSKESNYFYSSTQNNETELTSP
ILLPDLQIKITNIFRPGFSPTADSLALKDSFCTHVTEATKPEINKEDGEILGFDIYSQP
FGENADYPCEDKVDNIRQESGPVSNSEISLSFDLSRNTDVNHTSENQNSESLFTEPSNV
TTIDDGSRCFFTKSKTDYNDTKNKKEVESRISKRKLHISSRDQNIPHKDLRRHKIYGRK
RRLTSQDSSECFSSLSQGRIKTFSQSEKHIKSVLNILSDEASLCKSKCLSRKLDKAVVH
LKKAHRRVHTSLQLITKVGEERKGPLPKSYAVICNNFWESCDLQGYSSVSQRKYYSTKH
FSSKRKYDKRRKKRAPKADISKSLTHVSKHKSYKTSGEKKCLSRKSMASSVSKSHPTTS
HMGEFCNQEHPESQLPVSSTSQSTSQSVYYNSSVSNPSLSEEHQPFSGKTAYLFSPDHS
DEKLIEKENQIDTAFLSSTSKYEKLEKHSANHNVKDATKENSCDANEVINESNSVSLSC
IKENINSSTGNDCDATCIGHTKAKTDVLISVLDSNVKHFLNDLYQQGNLILSDCKRNLE
VKWTDPIERPKQSIITGNFLMGPLNLTLIASKKYSIPQVSAAAVTDSEGESSKSYLDKQ
RILTVDSFAASSTVPHCEQSCREKELLKTEQCSSGNCLHTDGNETNVTENYELDVASGT
EEDKSYGENIVELSSSDSSLLLRDNVKGSSSETCIVKKDTEDRITWKVKQAEKAKDSVY

Figure 57b

KRSMTEGSTVNTEYKNQKNQISEESCLNEKIITTNLIDSHLSTKNTTTESVPLKNTVSN
PLNKREKKGEIKVSKDSQSDLTLHSEIAYISKPGILGVNHTPILPAHSETCKVPTLLKK
PASYVSDFKEKHCSANHTALIANLSQILQRADEASSLQILQEETKVCLNILPLFVEAFE
RKQECSVEQILISRELLVDQNLWNNCKHTLKPCAVDTLVELQMMMETIQFIENKKRHLE
GEPTLRSLLWYDETLYAELLGKPRGFQQQSNFYPGFQGRLKYNAFCELQTYHDQLVELL
EETKREKNSYYVFLKYKRQVNECEAIMEHCSDCFDFSLSVPFTCGVNFGDSLEDLEILR
KSTLKLINVCGDSPKVHSYPGKQDHLWIIIEMISSKVNFIKNNEAVRVKISLYGLEHIF
FDAAKNLVWKERTQSFSKKYSQKKDEERLLRVNKCAFSKLQKIYDTLSKDLNNEPISPI
GLEEDTIIASRKSDHPINEATISIENSKFNSNLLAHPDICCISEILDQAEFADLKKLQD
LTLRCTDHLEILKKYFQMLQDNNMDNIFITEENVLDVVINHSHEAIILKPEAIEMYIEI
VMVSETIHFLKNSIAKKLDKQRFRGMLWFDLSLLPELVQCQEKMASFSFLKDNSTDVCL
WKVIETAVSELKKDLDIICKYNEAVNCSYAIHLLSRELQELSEIKKLLKKSKYFISTYI
DFVPYIASINYGSTVTELEYNYNQFSTLLKNVMSAPRKDLGKMAHIRKVMKTIEHMKMI
CTKNAELTISFFLCQMLYNRRKILQLKRKEKMNIHIVKPGENNNKFSISTMLPPVSECI
NKNISNSSKKRPSTVDKCEDSQEQQQDTTVSSCKKLKVDMKDVTKINREKATFKHPRTT
GSHPKSENKIVPSSCDSLKRNHLTPKKVEMQRSLPGSLLPLENPKDTCASKSESKIDLT
VSSDHFSGQQENLNSMKKRNVNFSAAETKSDKKDCAAFAICDQKSVHGTFSPDHGTLLQ
KFLKNSPDPTQKSCLSDINPETDVSLVPDASVLSKPIFCFVKDVHPDLEMNDTVFELQD
NDIVNSSIKNSSCMTSPEPICIQNKIPTLQINKLQPTETESEDKYMKDTLNPNTVHTFG
ASGHITLNVNQGAEYSLSEQQNDKNSKVLMQNAATYWNELPQSACNPTYNSSEHLFGTS
YPYSAWCVYQYSNSNGNAITQTYQGITSYEVQPSPSGLLTTVASTAQGTHSNLLYSQYF
TYFAGEPQANGFVPVNGYFQSQIPASNFRQPIFSQYASHQPLPQATYPYLPNRFVPPEV
PWVYAPWHQESFHPGH.

Figure 58a

SEQ ID NO.:58 hSPG5 genomic DNA sequence

ATGCCCAGTGATGCCAAAGACAGTGTTAATGGTGACCTTTTGTTAAATTGGACAAGTCT
TAAAAATATTTTAAGTGGTCTTAATGCTTCTTTTCCTCTTCACAACAATACTGGCTCAA
GCACAGTCACTACTTCAAAATCCATCAAAGACCCAAGACTGATGAGGAGAGAAGAAAGT
ATGGGAGAACAGAGTAGTACTGCAGGCTTAAATGAGGTTTTGCAATTTGAGAAGAGTTC
AGATAATGTTAATTCAGAAATAAAATCGACACCATCTAATTCTGCCTCCTCCTCAGAAG
TTGTCCCTGGTGATCGTGCTGTTCTTACTAATGGTTTGGATACCCCTTGCTTTAAAACT
TCTGTTAATGATTCACAATCTTGGGCTCACAACATGGGCTCTGAGGACTATGACTGTAT
ACCTCCCAATAAAGTTACCATGGCAGGGCAATGTAAGGACCAAGGTAATTTTTCCTTCC
CAATTTCTGTGTCAAATGTAGTGTCAGAGGTTGAGAACCAAAACCACAGTGAGGAGAAG
GCTCAGAGAGCCCAACAGGAGTCCGGTAATGCTTATACAAAAGAGTACAGTAGTCACAT
TTTTCAGGACTCGCAGTCTTCTGATTTAAAAACAATTTATCAGACTGGTTGCCAAACGT
CTACAGTTTTTCCACTCAAAAAGAAAGTAAGCATTGATGAATACCTTCAAAATACTGGA
AAGATGAAAAACTTCGCTGACCTGGAAGACAGTTCCAAACATGAAGAAAAGCAAACTTC
ATGGAAAGAAATTGATAATGATTTCACTAATGAAACAAAAATCAGTCCAATAGATAATT
ACATTGTTTTGCACCAAGAATACAAAGAGAGTGAGAGTCATAATTCTTTTGGGAAAAGC
TGTGATAAAATATTAATTACTCAAGAGTTAGAAATAACAAAATCTTCTACATCTACCAT
AAAGGATAAGGATGAACTAGATCATCTAGCATTGGAATGGCAAATTACTCCAAGTTTTG
AGAGCCTGTCACAAAAGCATCCTCAGCACTCTGTGGAGTATGAGGGTAACATTCATACA
AGTTTAGCCATTGCTCAAAAGCTAATGGAACTGAAATTGGGGAAAATAAATCAAAATTA
TGCTAGCATTATAACTGAAGCTTTCCCGAAACCAAAAGACATACCCCAGGCCAAAGAAA
TGTTCATTGATACAGTTATTTCATCTTATAACATAGAAACAGCTCATGACAGTTCAAAT
TGCAGCATAACTAGAGAACATATATGTGTCCATAGGAAAAATGAAAATGAACCAGTGTC
ATTAGAGAACATTCAGAGAGACTATAAAGAAACTGCTTATGTTGAAGATAGGGGTCAGG

Figure 58b

ATCACAATCTGTTCTGTAATTCACAGTTAAGCAATGATATATGGCTGAATGTTAATTTC
AAAAAACAAACAGATAGAGAAAACCAAAATGAGGCTAAAGAGAATAGTGCTTCATGTGT
AGAAAACAACATAGAGAACATATATGGAGACAAAAAGCAGGATTCTCATACAAACGAAA
ATTTCAGCAATATAGATGAAAAGGAGGACAAAAATTACCACAATATAGAAATTTTGAGT
TCTGAAGAATTTTCTACTAAATTTAACTTGATTTGCAGAGAAGATAATGCAGTGTCAGC
AGCAACTGCATTATTAGAGAGTGAAGAAGATACCATTAGTGCCGTGAAACAAAAAGATA
CTGAAAATACTGGAAGAAGTGTAGAGCATTTGGCTTCCACGACATTTCCCAAAACTGCA
AGTTCTTCAGTGTGTGTAGCCTCAAATGCTGCAATACAGATAGCTAGTGCTACTATGCC
TGCATTAAGCCTAAATAATGACGATCACCAGATATACCAGTTTAAAGAAACTTGTTCTT
CTGAAAGTCCAGATTTTGGTTTGTTAGTAAAACATAGGGTTTCTGATTGTGAAATTGAT
ACGGATAAAAATAAATCACAAGAATCATTTCATCAATCAATAAATGAGAACTTAGTTCT
TCAGAGCATTGAATTGGAAAGTGAAATTGAAATAGAATTAGAAGATTGTGATGATGCTT
TTATATTTCAACAAGATACACATAGCCATGAAAACATGCTTTGTGAAGAATTTGTGACC
TCATATAAGGCTCTGAAGTCTCGTATCAGTTGGGAAGGTCTGTTAGCACTTGATAACGG
GGAGATGGAAGTTTTGGAAAGCACCACAGGAAGGGAGAATAGTGATCAGCATTATTCTA
AGGAAAGTAACTATTTTTATTCCTCTACACAAAACAATGAAACAGAACTTACCAGCCCA
ATTTTACTTCCAGATCTACAAATTAAAATTACTAATATATTTAGGCCAGGATTCAGCCC
GACAGCTGACTCCCTTGCATTGAAAGATAGTTTTTGCACACATGTAACTGAAGCCACAA
AACCGGAAATAAATAAGGAAGATGGAGAAATTCTAGGATTTGACATTTATTCCCAGCCT
TTTGGTGAAAATGCAGATTATCCATGTGAAGATAAAGTTGATAATATAAGGCAAGAATC
AGGGCCAGTGAGTAACTCTGAAATCTCCCTTTCTTTTGACTTGAGTCGTAATACAGATG
TGAATCATACGTCTGAAAATCAGAACAGTGAATCTTTGTTTACTGAACCTTCTAATGTC
ACAACAATAGATGATGGAAGCAGATGTTTCTTTACAAAATCAAAAACTGACTATAATGA
TACCAAAAATAAAAAGGAGGTAGAATCAAGAATTAGCAAAAGGAAGCTACATATATCTT
CCAGGGATCAGAACATACCACATAAAGATTTAAGACGACATAAAATTTATGGAGAAAG
AGGAGGCTAACCAGTCAAGACTCATCTGAGTGTTTCTCTTCATTATCCCAAGGACGAAT
TAAAACATTTTCACAGTCAGAAAAGCACATTAAGAGTGTCCTAAATATCCTAAGTGATG
AAGCATCTTTATGTAAAAGCAAATGTCTTTCCAGAAAACTAGACAAAGCAGTTGTTCAC
TTAAAAAAAGCTCATAGAAGAGTTCACACATCTTTGCAGCTTATAACTAAAGTAGGAGA
AGAAAGAAAGGGCCCATTACCAAAATCATATGCAGTAATATGCAATAATTTCTGGGAAA
GTTGTGACCTTCAAGGTTATAGTTCTGTGTCTCAAAGAAAATATTATTCTACTAAGCAT
TTTTCGTCAAAAAGAAAATATGACAAACGGAGAAAGAAAAGAGCTCCAAAAGCTGATAT
TTCTAAATCATTAACCCATGTGTCAAAGCACAAGTCTTATAAAACAAGTGGAGAGAAAA
AATGCCTTTCTAGGAAAAGTATGGCTAGCAGTGTCTCAAAAAGTCACCCCACCACCAGT
CACATGGGAGAATTTTGTAATCAAGAACATCCTGAATCACAGTTGCCTGTATCCTCCAC
ATCCCAAAGTACAAGTCAGTCAGTTTATTATAATAGCAGTGTAAGCAATCCAAGTTTAT
CAGAAGAACATCAGCCCTTTTCTGGAAAAACTGCATATCTGTTTTCCCCAGACCACTCA
GATGAGAAACTAATAGAAAAAGAAAATCAAATTGATACAGCATTTTTATCTAGCACTAG
TAAATATGAAAAGCTTGAAAAACATTCAGCAAATCATAATGTTAAAGATGCAACTAAAG
AAAACAGTTGTGACGCTAATGAAGTAATAAATGAAAGTAATTCTGTATCTTTAAGTTGC
ATAAAAGAAAACATAAATTCTAGTACAGGCAACGATTGTGATGCAACTTGCATAGGTCA
CACAAAGGCGAAAACTGACGTACTTATATCAGTCTTAGATTCAAATGTGAAGCACTTTT
TAAATGATCTCTACCAACAAGGTAACCTTATTTTATCTGATTGTAAAAGAAACCTGGAA
GTAAAGTGGACAGATCCTATTGAGAGACCCAAACAAAGCATTATTACAGGAAACTTCCT
TATGGGCCCATTAAACCTAACTTTGATAGCAAGTAAAAAGTACAGTATTCCTCAGGTAT
CAGCCGCTGCAGTGACAGATAGTGAGGGAGAATCTTCAAAATCTTACTTGGATAAGCAG
AGAATTCTTACTGTAGATTCTTTTGCAGCATCCAGTACTGTACCACACTGTGAGCAGAG
CTGTAGAGAAAAAGAGCTTCTAAAGACAGAACAGTGCTCTTCAGGTAATTGCCTCCATA

Figure 58c

CAGATGGGAATGAAACAAATGTCACTGAGAATTATGAGTTGGATGTAGCATCAGGAACT
GAAGAAGATAAAAGTTATGGGGAAAATATAGTGGAATTATCTTCCAGTGATAGTTCTCT
GCTTTTAAGAGATAATGTAAAAGGCTCCTCTTCAGAAACATGTATTGTGAAGAAAGACA
CTGAGGACAGAATAACGTGGAAAGTTAAACAAGCGGAAAAAGCAAAAGATTCTGTTTAC
AAAAGAAGCATGACTGAAGGATCAACTGTTAATACTGAGTACAAAAATCAAAAGAATCA
GATCTCAGAAGAATCCTGCTTAAATGAGAAAATTATTACAACTAACTTGATTGATTCCC
ATCTGAGCACTAAAAATACTACCACTGAGTCAGTCCCTTTGAAGAACACAGTTTCTAAT
CCGCTTAACAAAAGAGAGAAGAAGGGGGAAATTAAAGTTAGTAAAGACTCGCAGTCTGA
CTTGACATTACATTCAGAAATAGCCTATATTTCCAAACCAGGAATTCTAGGAGTTAATC
ATACGCCTATTTTACCTGCCCACTCTGAAACCTGTAAAGTCCCTACTCTTCTGAAGAAA
CCTGCGTCATACGTGAGTGATTTTAAAGAAAAACATTGCTCAGCTAATCATACGGCCCT
TATAGCTAATCTATCTCAAATTTTGCAGAGGGCAGATGAAGCATCATCTTTGCAGATTC
TACAGGAAGAAACTAAGGTTTGTCTAAATATTCTCCCTTTATTTGTGGAAGCTTTTGAA
AGAAAGCAAGAATGTTCAGTTGAACAAATCCTGATTTCAAGAGAACTGTTGGTAGACCA
AAACCTGTGGAATAATTGCAAACACACATTAAAACCATGTGCTGTTGACACTTTGGTAG
AACTTCAAATGATGATGGAAACAATTCAATTCATTGAAAACAAAAAAAGGCACTTAGAA
GGTGAACCAACATTGCGAAGCTTGCTTTGGTATGATGAAACACTGTATGCTGAGCTTCT
TGGAAAACCACGTGGATTTCAACAGCAGTCTAATTTCTATCCTGGTTTCCAAGGAAGAT
TAAAATATAATGCATTCTGTGAGTTACAGACTTACCATGATCAATTAGTTGAATTGCTT
GAAGAAACAAAAAGGGAAAAGAATTCATACTATGTATTCTTAAAGTACAAACGACAGGT
TAATGAATGTGAAGCCATAATGGAGCATTGTTCCGATTGCTTTGATTTTTCTCTTTCTG
TTCCATTTACCTGTGGAGTTAACTTTGGAGATAGTTTAGAAGACCTGGAAATCTTAAGA
AAAAGTACTTTAAAGTTGATCAATGTATGTGGGGACTCTCCTAAAGTTCATTCGTATCC
AGGAAAACAGGACCATCTGTGGATTATCATAGAAATGATCTCCTCAAAGGTTAATTTTA
TTAAGAACAACGAGGCAGTACGTGTTAAAATATCTCTTTATGGTCTGGAACATATCTTT
TTTGATGCTGCAAAAAATCTTGTTTGGAAAGAGAGAACACAATCCTTCAGCAAAAAATA
CTCACAAAAGAAGGACGAAGAAAGGCTACTCAGAGTGAATAAATGTGCCTTTTCTAAGT
TGCAGAAGATATATGATACTTTGTCTAAAGATTTAAACAATGAACCAATTTCCCCTATT
GGGCTTGAGGAGGATACTATAATTGCTTCCAGAAAGTCAGATCATCCAATAAACGAAGC
AACAATTAGCATAGAAAATTCTAAATTTAACAGTAATTTGCTTGCACACCCAGATATTT
GTTGTATTAGTGAGATATTGGATCAGGCTGAATTTGCAGACCTTAAAAAATTACAGGAT
CTCACCTTGAGATGTACAGATCACTTAGAAATTTTAAAAAAATACTTTCAGATGCTACA
AGATAATAACATGGATAATATTTTTATCACAGAAGAAAATGTTTTAGACGTGGTGATAA
ACCACAGCCATGAGGCTATCATTTTAAAGCCTGAAGCTATTGAAATGTATATTGAAATC
GTCATGGTCTCAGAAACAATTCACTTTCTTAAAAACTCAATAGCAAAGAAACTAGACAA
ACAGAGGTTTCGAGGTATGCTTTGGTTTGATTTGTCACTTCTTCCTGAGCTGGTTCAGT
GCCAAGAAAAAATGGCTTCTTTTTCATTTCTTAAAGATAACTCAACAGATGTTTGCCTT
TGGAAAGTGATAGAGACTGCTGTTTCCGAACTTAAGAAAGATCTGGATATTATCTGCAA
ATATAATGAAGCTGTTAATTGCTCATATGCTATTCATTTGCTCTCAAGAGAACTTCAAG
AACTTTCAGAAATAAAAAAGCTTCTGAAGAAGTCCAAGTATTTTATTTCCACATATATT
GACTTTGTGCCATATATAGCATCCATAAATTATGGAAGCACTGTGACAGAGTTAGAATA
CAACTACAATCAATTTTCTACACTGCTGAAGAATGTAATGTCTGCCCCTAGGAAAGATT
TAGGAAAAATGGCCCACATTAGGAAAGTCATGAAAACGATTGAACATATGAAGATGATA
TGTACTAAAAATGCTGAACTAACCATTTCCTTTTTCCTATGCCAAATGCTGTATAACAG
AAGGAAGATTTTACAGCTGAAGAGAAAAGAAAAAATGAATATTCATATTGTAAAACCTG
GGGAAAATAACAATAAATTTAGTATTTCTACGATGTTGCCCCCAGTATCAGAGTGCATA
AACAAAAACATCTCAAATTCCTCTAAAAAACGACCGAGCACTGTAGACAAATGTGAAGA
CTCTCAGGAACAACAGCAAGATACTACTGTTTCCAGTTGTAAAAAGCTAAAGGTATGTA

Figure 58d

TGTTTTAAAACAAAACTTTTATAAGTATTCTTTTTGAAAACAAGTCTACTCATAAGCAA
ACAAGTAGTTTGCAGAATTCTAAAAGTTAAGAATGGTAAATTGTCTGGCAAAATGAATT
TACTAACTATAATATTGATTTAAACAATTCATATTATCTATAAAATGATACATAAATTA
TATGTATAGGTGATACCTTGCAAATGTCTACTTTTTAAACGTAAATGTTTTAACTTAGA
AAACATTTTTTGGAAGGACGTGGATTTTAAAAGCTTCTTAAGAAGGAGTTCAATATTAT
GAACACTGAGTGAGTGACCAATATTTATTGAGTAGCTTTTCTGTATAGCAAGCCTATGC
CCCGTGTAGTGAATATTAAAAAGTGGCTAACAAAGCCTGTCTTCTTGACCATTATCATC
CCAATGGAGAAATAGGACAGATATTTTTCAAGAGATAATTATCAAGGAGTTAAAAGTCC
TATATTAAATACATTTTAACAAATTGTCTAAAGCATTTAATATGTACTTGGCACTGATT
TATTTTATACACAACCCCTTATGATGTATTTCCTATTATCTTACTTCAAGATAAGGAAA
GTGGGACACAGAGGAAATGACTATCCTGGGGTCACAGAATTTAGTAAATGGGAGCACCC
AGATCTAAACCAGGCAGTCTGGCCTCCAGAGCCCTTATTGACAGTTGTCTCAGCACTGC
TCTAAGAGGTTTCTCTTACAGCTGTTCAAGACTTCTTAGTTCAGAAGTTTAGAAAAGAA
ACCTATATGCAGCTGGGTGCGATAGCTCACGCCTGTAATCCCGGCACTTTGGGAGGCCA
AGGTGGGCAGACTGCTTGAGTCCAGGAGTTCAAGACCAGCCTGGGCAACATGGTGAGAC
CTCATCTCTACTAAAAATAACAAAAAATTAGCCAGACATGGTGACATACACTTGTAGTT
CCAACTACTTGGAAGGTTGAAGCAAGAGGATTGCCTGAGCACAGGGGCGGAGGTTGCAG
TGAGCCAGGATTACACCACTGTACTCCAAGCTGGGAGGACAGAGTAAGACTCTGTTTCA
AAAAAAATTTATATATATATAATTTTTAAATTAAGTCTGGAACAATTTAACTTAGTGGGTA
AGAATAATCTATGGATGGAGAAGGTTATTTCAGATTATGGAATATCTTAAATTAGACCT
AAGGAGTTTGACCTTCATTCTGTACACATTGAAGTGTACTGTCATATGAAATTCGTTTT
TCTAATGATTTAACAGATAGATTCTGAGTATATAAGTCATATATGTCTTCTGTAGAAGT
ATATATAGTAATAAGTAGTAGTACTGTATACAATACTACTTACAGTAATAAGTCAGCCA
TGGCTTAGAAAAAGGTGTTAGAAAGGAAAATTCATATTGACAGACATGACTTAAAGAAT
CGATGGGGCTTAGCAACTGGTTTACAAGAAAGGACATAAAAGAGGGAGGGAATAGTCAT
AAATGGACTTCAAGGTTAGTTTTAAGGGCCAGGTGTGGTGGCTCTTGCCTGTAATCCCA
GCACTTTGGGAGGCTGAGGCAGATGGATCACCTGAGGTCAGGAGTTCGAGACCAGCCTG
ACCAACATAGTGAATCCCCATCTCTACTAAAAATACAAATATCAGCTGGGTGTGGTGGT
GGGCACCTTTAGTCCCAGCTACTCTGGAGGCTGAGGCAGGAGAATCGCTTGCACCCAGT
AGGCGGAGGTTGCAGTGAGCCAATATCGCATCACTGCACTTCAGCCTGGGTGACAGAAT
GAGACTCCATCTCAAAAAAAAAAAAAGATGTGAGGATAAGAAGAATGTTACAAATTTATT
TTTTTTAAAGTTACTCCAAACATATATGAAATATGGGAAGTCTAGGAGAGTCACTGCTT
TCTGCAGGGAGGTGATAATTAATTAGTTTAACTTTAGATGATGGCAGAACAAGCAATTA
AAAATATCTAATATTGAAATAATAATTATTTTTATTATAGTTTGTCATCACTAATGAAG
ATTTTCTTTGTATCTTTTAAACACAGGTAGACATGAAAGATGTCACAAAAATCAACAGA
GAAAAGGCAACATTCAAGCATCCAAGGTAGGAGTTCCCATCAGCCCTATGTGGAAAAAA
AATTGAACAAAATTGGGCAAATACTAAACAACTAGAATAACACAATTATTTATATAATG
TCATTGGATCATACATGTAACTTAGGGGATGAGAGTAAGCTAAGGAAAAAGAAATTTGT
TTGAAATTATACAGTTTCTTAAATTCAGCCTAAGGAGTTTGAACTTCATTCTGTAAGTA
TTAAAGGCTAAAGTCATGTGAAATTTGCTTTTTCAGTGATGTAAAGGTTAACAATATTC
TGAGTATAGTTAGAAGTAAGTCAGCCAAGGCTTAGAAAAGGGTGATTGTTTCACAGAAT
AAGAAAGAAAAATTTATATCTTTACAAGATACGATACAATACATAAAGAATTGATGGGG
CTTAGTAAGTGGTTTACCAAAAAAAGACTTCTAAAATCAAAAAGGGACTTTTAAAAATA
GGACAAGTGATAAGATTACTTTTTTTTTAACTTGTGCATTTTGAAGAATGGCAAATTTC
AAAACTGGCATTTTAATGAGAACCTACATAGTCATCAATTCCCATACGATACTTTGAGC
TCTCAGAAAGTATAATTTTGATTTTATCGCATTTCTGGTGATGTTTCAGTGAGGCTGAA
TTCAGTGAAATATTTGGCTTTTAGTTTGTTGAGTGGGATATGTGAATTCCAGGCCAAAG
AAGAATTTCTCTTGACTACAGAGAAATAGTACTACTTTTCCCTTCTCAACATAATATTT

Figure 58e

CCTCATACAATTTAAGAATTTCATAAAGCACCAAAAAATCTAATTACTGGCTGGGTGTG
GTGGCTCATGCCTGTAATCCCTGCACTTTGGGAGGCCAAGGCGGGCGGATCACCTGAGG
TCAGGAGTTGGAGATCAGCCTGACCAACATGGTGAAACACTATCTCTACTAAAAATATG
GAAACTAGCCGGGCATAGTGGCGGGTGCCTGTAGTCCCAGCTACTTGGGAGGCTGAGGC
AGGAGAATCATTTGAACTTGGGAGGCGGAGGTTGCAGTGAGCTGAGATGGTGCTGCTGC
ACTCCAGCCTGGGCAACAGAGTGAGACTCTGTGTCAAAAAAAAATTCATATATATATAT
ATATATATATATATATATATATATATATATATATATGTTTTTATATATACACACATACA
CATACATATGTGTGTATGTGTGTGTGTATATATGTGTGTGTGTGTGTGTGTATATAT
ATAATTACCTCAGGGACCTATATTAACTGTCTGGCTTTAGACAATTCCCATTTGGATGC
TTCTCTCAGCTGCTTGAGACTGTCTGAATTTAGCTAATAATTTCAAGGCTATTAAATTG
GGCAAGAAATTTTGGAGATCTGCTTTTCCTATTCTCAAAGATGAACAGACAAAAACGTA
TTAGTCTGTTATAACAGAGAGGGAAGAAATCTTTGGTGGGAAGGCAGGGGTTACAGCTG
GTAGTTTACCAGTTATTTATAGCTATTTACAAGTAATGAAGATCATCAGGCAGGAGGCA
TATGAATTAAAAAACTATACTGAACAATTGACTAGTGATAGTTTCTACTTTTAAAAGC
CTCCATTAGAAAATGTCTAATGCACAAAATAGTTTATTACAATATTGGAAATATATTTA
AAATGTAGAGCATATCATCTTCAGTAGGAAAAGTATCTAAATCCAAACCACGGCAGTCA
AACTAGGAAAATGTTAACTTGTATAGTGCCAATAGAATGGGAAAACGTAAAGCTTAAGA
ACTCTTCCCCTGGATAAAAATTTCAAATATATATTTCCATTAAAATTTTATGACCCTAT
ATATTTAAATTCATTTTTATGTATGTGTTGCACCTAATAGGACTACAGGATCTCATCCC
AAAAGCGAAAACAAAATAGTACCAAGTTCATGTGACAGTCTGAAAAGAAATCATTTAAC
GCCAAAAAAGGTTGAAATGCAAAGATCACTACCTGGCTCACTTTTACCCTTAGAGAACC
CAAAAGACACTTGCGCATCAAAGTCGGAAAGCAAAATAGACTTAACTGTTTCATCTGAT
CACTTCAGTGGACAACAGGAAAATTTAAATAGCATGAAGAAAAGAAATGTGAACTTCAG
TGCTGCTGAAACAAAAAGTGATAAGAAAGATTGTGCTGCTTTTGCAATTTGTGACCAAA
AAAGTGTACATGGCACATTTTCACCAGACCATGGACGCTTTTGCAGAAATTTCTTAAA
AATTCCCCAGATCCCACCCAAAAATCCTGCCTTTCTGATATAAACCCAGAAACTGATGT
TTCTCTTGTGCCTGATGCGTCGGTGCTCTCAAAGCCAATTTTCTGTTTTGTGAAAGATG
TCCATCCTGATCTAGAAATGAATGACACAGTCTTTGAACTTCAAGATAATGATATAGTA
AATTCATCTATTAAAAATTCCTCATGCATGACTTCTCCAGAACCCATCTGTATCCAGAA
CAAAATTCCTACTCTGCAGATAAACAAACTACAGCCTACAGAAACTGAGTCAGAGGACA
AATACATGAAGGATACATTGAATCCCAATACTGTGCATACTTTTGGAGCATCTGGGCAT
ATAACCCTTAATGTGAATCAAGGAGCAGAGTACTCTCTTTCTGAACAACAGAATGACAA
AAATTCAAAAGTCCTAATGCAGAATGCTGCCACATATTGGAATGAACTTCCACAGTCTG
CATGTAACCCAACATATAATTCTTCTGAGCATTTATTTGGAACTTCATATCCATACTCT
GCTTGGTGTGTTTATCAGTACAGCAACAGCAATGGCAATGCCATTACCCAGACATACCA
AGGGATAACATCATATGAAGTACAGCCATCTCCTTCTGGGCTGTTGACCACAGTTGCAA
GTACTGCCCAGGGCACACATTCTAATCTTCTGTACTCTCAATATTTTACTTATTTTGCG
GGGGAGCCACAAGCAAATGGCTTTGTGCCAGTGAATGGGTATTTTCAATCTCAAATACC
TGCTTCTAATTTTCGGCAGCCAATTTTTCACAATATGCTTCTCATCAGCCATTACCAC
AAGCTACATACCCTTACCTTCCTAATCGATTTGTGCCTCCAGAAGTTCCTTGGGTTTAT
GGTGAGTTTCACATTTTAATGCCTGCTTTATTGAGTTGTTACTTTTAA

Figure 59a

SEQ ID NO.:59 hSPG15 cDNA sequence

CGGGGCAGCCTAGGCCGGGCGAGGGCCATGCTGAGCCTCGCAGCCAAGCTGGTGGCCTT
CTTCTGGAGGACGGCGGACACCCCTAGGGAGGAAGCCGGGCAGCTGGAGCCCGAGCTCG
CGGAAGGTGACACTAAGCTGAAAACTGTACGGGGTGTCGTGACAAGGTACTGCAGCGAT
TATGGCATGATTGATGATATGATCTACTTCTCCAGTGATGCTGTGACTAGCAGAGTGCT
TCTGAATGTTGGACAGGAAGTGATTGCAGTTGTGGAAGAAAATAAAGTGTCCAATGGAC

Figure 59b

TGAAAGCAATCAGGGTAGAAGCTGTCTCTGATAAGTGGGAAGACGACAGCAGAAACCAT
GGGAGTCCCTCAGACTGCGGCCCCCGAGTGTTGATTGGCTGTGTGACTTCCCTGGTGGA
GGGCGCAGGCTGTATCAGTCAGACCACCTACTTCTCTCTGGAGAGTGTGTGCGAAGGCT
TCGAGCCCTGCAAGGGAGACTGGGTGGAGGCTGAGTACCGGATCCGGCCTGGCACGTGG
AGCAGCGAAGCCACCTCAGTGAAGCCACTGAGATACAAGCGCGTGGACAAGGTCTGCAT
CTCTAGCCTCTGTGGAAGGAACGGGGTGTTAGAGGAAAGCATCTTCTTTACCTTGGACT
CCTTGAAACTGCCAGATGGGTACACACCCCGGAGAGGTGACGTGGTCAATGCAGTGGTG
GTGGAGAGCAGCCAGTCATGCTATGTCTGGAGGGCGCTTTGTATGACCCTAGTGAAGAG
GCGAGACGCCGCCCCTGTTCATGAGGCCACTCATTTCTATGGAACGATTTTGCTGAAGA
ACAAAGGTGATATTGAAGTTACACAGGTGACGCATTTTGGAACCCTAAAGGAAGGAAGA
AGTAAAACCATGGTGATCTGGATAGAGAATAAAGGAGACATTCCTCAAAACTTAGTCAG
CTGTAAACTGGCTGGCTGGGATAAATCTAAACAATTCAGATTCCAAATGCTGGATAAAG
ACCAGATGTGCCCCGTGGTATCTTTTGTTTCTGTTCCTGAGAAGGAGAATTCATCAGAT
GAAAATATTAATTCATTAAATAGCCACACAAAAAACAAAACCTCTCAGATGTCGGAGAG
CAGTTTGGTGAACAACAGAGGAATCTCTCCAGGTGATTGTACCTGTAAAGGAGAAAATG
GAGAAAAAGACAACATTCTATCAAGGAAGCAGATGACAGAGCCTGAGCCTGGGGGCTT
GTCCCTCCAGGGGGAAAAACCTTCATTGTGGTCATCTGTGACGGAAAAAATCCTGGCCG
CTGCAAGGAGCTCCTTTTGCTTTGTTTTTCCGATTTCCTAATTGGGCGATACCTTGAAG
TAAATGTTATCAGTGGGGAGGAGTCACTAATTGCTGCGCGCGAACCATTTTCTTGGAAA
AAGCTTAAAAGTTCACAAGCGTTAACATCCGCAAAAACTACAGTTGTTGTGACCGCACA
GAAAAGGAACTCAAGACGACAACTTCCAAGTTTTCTTCCCCAATATCCAATCCCAGATA
GACTTAGAAAATGTGTGGAACAAAAAATTGACATCCTGACTTTCCAGCCATTACTTGCA
GAGCTTCTGAACATGTCAAATTACAAGGAGAAGTTTTCGACTTTGCTGTGGCTTGAGGA
GATTTATGCAGAAATGGAACTGAAAGAGTATAACATGAGCGGGATCATCTTAAGAAGGA
ATGGGGATCTGCTGGTTCTGGAGGTCCCAGGGTTGGCCGAAGGGAGGCCTTCTCTCTAC
GCAGGTGATAAACTGATTTTAAAAACTCAAGAGTACAATGGACATGCCATCGAATACAT
CAGCTACGTGACTGAGATTCATGAAGAAGATGTAACTCTTAAAATTAATCCAGAATTTG
AACAAGCCTATAACTTTGAACCTATGGATGTGGAATTTACATATAATAGGACCACAAGC
AGACGGTGTCACTTTGCACTTGAACACGTCATCCACTTAGGTGTAAAAGTGTTGTTTCC
AGAAGAAATTATTTTACAGTCTCCACAAGTGACGGAAATTGGAACCATGCACAAGACA
CCAAAAGCAGTGGACAGTCCACCAGCAAAAAGAATAGGAAAACAATGACGGACCAAGCT
GAGCATGGAACAGAGGAGAGGCGTGTTGGTGACAAGGACCTGCCGGTGCTGGCACCCTT
TACTGCAGAGATGAGCGATTGGGTAGATGAAATTCAGACCCCTAAAGCAAGAAAGATGG
AGTTTTTCAACCCAGTGCTAAATGAAAATCAGAAGTTAGCAGTTAAAAGGATTCTGAGT
GGTGACTGCCGTCCCCTCCCGTATATTCTCTTTGGACCTCCTGGTACTGGAAAGACAGT
GACAATAATAGAGGCTGTTTTACAGGTACACTTTGCCTTGCCGGACAGTCGGATTTTAG
TCTGTGCGCCCTCCAACAGTGCTGCTGACCTCGTGTGTCTGCGGCTGCACGAGAGCAAG
GTGCTACAGCCGGCCACCATGGTCCGGGTGAACGCCACCTGCAGGTTCGAGGAGATAGT
TATTGACGCCGTCAAACCGTATTGCAGAGACGGAGAAGACATCTGGAAAGCCTCACGCT
TCCGGATAATCATCACCACATGCAGCAGCTCAGGGCTGTTTTACCAAATAGGAGTGAGA
GTTGGGCACTTCACTCACGTGTTTGTGGACGAGGCTGGGCAGGCAAGTGAGCCGGAATG
CCTCATTCCTCTGGGGCTGATGTCGGACATCAGTGGCCAGATCGTGCTGGCAGGAGACC
CCATGCAGCTCGGACCAGTCATTAAGTCCAGACTCGCCATGGCCTATGGGCTGAACGTG
TCCTTTTTGGAACGGCTGATGTCTCGACCCGCGTACCAGAGGGACGAAAATGCTTTCGG
TGCTTGTGGCGCACATAATCCCCTGTTGGTCACAAAGCTGGTGAAGAACTACCGGTCCC
ACGAGGCCCTGCTGATGCTGCCCTCACGGCTGTTCTACCACAGGGAACTCGAGGTCTGT
GCGGACCCCACAGTGGTGACCTCCTTGCTGGGCTGGGAGAAGTTGCCTAAGAAAGGCTT
CCCTCTCATCTTCCATGGTGTGCGGGGCAGCGAGGCACGGGAGGGAAAAAGCCCATCGT

Figure 59c

GGTTCAACCCGGCCGAGGCCGTCCAGGTCCTGCGCTACTGCTGCCTCCTGGCCCACAGC
ATCTCCAGTCAGGTGTCTGCCAGCGACATTGGCGTCATCACGCCCTACCGGAAGCAGGT
GGAGAAAATCAGAATTCTTTTGCGTAATGTTGATCTGATGGATATAAAGGTTGGATCAG
TAGAGGAGTTTCAAGGACAAGAGTATCTGGTCATCATCATTTCGACCGTACGGTCAAAT
GAAGATAGATTTGAAGATGATCGATATTTTTTGGGTTTCTTGTCCAACTCAAAAAGATT
TAATGTTGCAATCACCAGACCCAAAGCTTTGCTGATAGTGCTGGGAAACCCCCATGTTC
TCGTTCGAGACCCCTGTTTTGGTGCTTTGCTGGAATACAGTATTACAAACGGTGTTTAC
ATGGGATGCGATTTACCTCCTGCACTGCAGTCTCTGCAAAACTGTGGCGAGGGGGTGGC
AGACCCCTCCTACCCAGTGGTGCCAGAATCCACAGGACCAGAGAAGCATCAGGAGCCCA
GCTGATCTGCAGTGGCTGACAGCAGGGAGGCCATGTGCTCAGCCTGGCCACGTTGCCGT
TACAGTCTGCTCCGTGGCTCCTGTGGCCTGCCCTTGTCTCGCAGCCAGGCAGGGTCGTG
TGTGGGTGTGGGGCTGCCAGGTTGGACGCAGCTGCTGCTGCCCTGACTTTGGCATATGC
CAGCCTGTTCCTGCCACAGGGCAGTCACTGCCGCCTACCCTGAAATAAACCCTCGAGTG
ACCCCCAAAAAAAAAA

SEQ ID NO.:60 hSPG15 encoded protein sequence Figure 60

MLSLAAKLVAFFWRTADTPREEAGQLEPELAEGDTKLKTVRGVVTRYCSDYGMIDDMIY
FSSDAVTSRVLLNVGQEVIAVVEENKVSNGLKAIRVEAVSDKWEDDSRNHGSPSDCGPR
VLIGCVTSLVEGAGCISQTTYFSLESVCEGFEPCKGDWVEAEYRIRPGTWSSEATSVKP
LRYKRVDKVCISSLCGRNGVLEESIFFTLDSLKLPDGYTPRRGDVVNAVVVESSQSCYV
WRALCMTLVKRRDAAPVHEATHFYGTILLKNKGDIEVTQVTHFGTLKEGRSKTMVIWIE
NKGDIPQNLVSCKLAGWDKSKQFRFQMLDKDQMCPVVSFVSVPEKENSSDENINSLNSH
TKNKTSQMSESSLVNNRGISPGDCTCKGENGEKDNILSRKQMTEPEPGGLVPPGGKTFI
VVICDGKNPGRCKELLLLCFSDFLIGRYLEVNVISGEESLIAAREPFSWKKLKSSQALT
SAKTTVVVTAQKRNSRRQLPSFLPQYPIPDRLRKCVEQKIDILTFQPLLAELLNMSNYK
EKFSTLLWLEEIYAEMELKEYNMSGIILRRNGDLLVLEVPGLAEGRPSLYAGDKLILKT
QEYNGHAIEYISYVTEIHEEDVTLKINPEFEQAYNFEPMDVEFTYNRTTSRRCHFALEH
VIHLGVKVLFPEEIILQSPQVTGNWNHAQDTKSSGQSTSKKNRKTMTDQAEHGTEERRV
GDKDLPVLAPFTAEMSDWVDEIQTPKARKMEFFNPVLNENQKLAVKRILSGDCRPLPYI
LFGPPGTGKTVTIIEAVLQVHFALPDSRILVCAPSNSAADLVCLRLHESKVLQPATMVR
VNATCRFEEIVIDAVKPYCRDGEDIWKASRFRIIITTCSSSGLFYQIGVRVGHFTHVFV
DEAGQASEPECLIPLGLMSDISGQIVLAGDPMQLGPVIKSRLAMAYGLNVSFLERLMSR
PAYQRDENAFGACGAHNPLLVTKLVKNYRSHEALLMLPSRLFYHRELEVCADPTVVTSL
LGWEKLPKKGFPLIFHGVRGSEAREGKSPSWFNPAEAVQVLRYCCLLAHSISSQVSASD
IGVITPYRKQVEKIRILLRNVDLMDIKVGSVEEFQGQEYLVIIISTVRSNEDRFEDDRY
FLGFLSNSKRFNVAITRPKALLIVLGNPHVLVRDPCFGALLEYSITNGVYMGCDLPPAL
QSLQNCGEGVADPSYPVVPESTGPEKHQEPS. **SEQ ID NO.:61 hSPG15 genomic DNA sequence** Figure 61a

GGGGGTCACTCGAGGGTTTATTTCAGGGTAGGCGGCAGTGACTGCCCTGTGGCAGGAAC
AGGCTGGCATATGCCAAAGTCAGGGCAGCAGCAGCTGCGTCCAACCTGGCAGCCCCACA
CCCACACACGACCCTGCCTGGCTGCGAGACAAGGGCAGGCCACAGGAGCCACGGAGCAG
ACTGTAACGGCAACGTGGCCAGGCTGAGCACATGGCCTCCCTGCTGTCAGCCACTGCAG
ATCAGCTGGGCTCCTGATGCTTCTCTGGTCCTGTGGATTCTGGCACCACTGGGTAGGAG
GGGTCTGCCACCCCCTCGCCACAGCTGTAGACAGAGGAGAAGCGGATGGCCAGTGAGCC
AGGCTCCCACAGCGGGCTGGGAGCTGCACTCTTTTCCCAATGTGGGTTTTACAAGGGGA
CTTAGTTTACCCTGTTAGCCTATGTGGGAAAGGTGACATGACCCCAAATGTCCAGGAAA
CAGTGGCTGCTGCAGCCCAGGATGAGGTGAGGACGGTGGCCGGCAGAGGGCTAAGGCTG
CAGGTGGGTAAGTGGATGGGGGTGAGGGGAGCAGGGGAGGGCAGGCTAGAGCACGTTCT

Figure 61b

AGAGCCAGCCTGTCTTTGAGGAAGACAGCAGAAGCGCTCACTTTTGCAGAGACTGCAGT
GCAGGAGGTAAATCGCATCCCATGTAAACACCGTTTGTAATACTGTATTCCAGCAAAGC
ACCAAAACAGGGGTCCTGTTGGCAATAACAATTAGCCTGGTGTGAGAGCAAGTGAAGGC
CCCATGTCTCCTGGTGCCTCGTACGTCTCACCCCGAGTGACCCGGACCCTCCCTCCTTA
AGTGATCACAGCCCACCCAGTGCCTGAAAACTCACTCGAACGAGAACATGGGGGTTTCC
CAGCACTATCAGCAAAGCTTTGGGTCTGGTGATTGCAACATTAAATCTTTTTGAGTTGG
ACAAGAAACCCAAAAAATATCGATCATCTTCAAATCTATCTTCATTTGACCGTACCTAA
AAGCACACAGAGATGAATAAAAATGGCACTTGAAGTTTTTGGGGGGCATGAAGAGAAAC
TCTTGATATATAAAAACATTTAAAAATGTTAAATAGCAGAATGACCTCATTTTTGGTTC
AAAAAGAAACAGGAGGCCGGGCGCGGTGGCTCACGCCTGTAATCCCAGCCTTTGGGAGG
CCGAGGCGGGAGGATCACGAGGTCAGGAGATCGAGACCATCTTGGCTAACATGGTGAAA
CCCCGTCTCTACTAAAAATACAAAAAAAAAAAAATTAGCTGGGCGTGGTGGTGGGCGCC
TGTAGTCCCAGCTACTCGAGAGGCTGAGGCAGGAGAATGGCGTGAACCCGGGAGGCAGA
GCTTGCAGTGAGCCGAGATCGCGCCACTGCACTCCAGCCTGGGCGACAGAGCGACGCCA
TCTCAAAAAAAAAAAAAGAAAGAAAAAAAGAAACAGGAGGTGGGGGGAGGGGGAGAAGG
GGGAGGAGGAAGGGCAGCAGAAAGGGGTGGGTCTCATCGGCACTCCATCTGCAGACAGG
GAGCCCTCACGCTTGCGGCTGTCTGGATGGCGGGGTCTTAGGGGCTCTCCTGCGGGTAC
CTGCCCTCCCACTCTCTGCTCCTCAGCTGCCTGTTCTTCCAACTTCGTGTCCCTCCTTC
TCCAAGGCATTCACCATGTCTTCCTGGGTCCCTTCTCTTTACTCTCCTGTGTCTTAGTC
TTTGAGTATTGTTTTAAAAGACCTTCCCACAGCCACTGCTTACAATGGCTCCTGGACCT
AGGGAGTCTCCGCCTGCAGCTGCTTCTCTGGGCTGGGAATCAGCCTCTGCCCCCTTTAGA
TCTGAAGCCCCCAGAACCCCCAGGGCAGCAAGCACCTGACTGTCCATCCCCACGGAGAA
CAGGGATACCTACGGTCGAAATGATGATGACCAGATACTCTTGTCCTTGAAACTCCTCT
ACTGATCCAACCTTTATATCCATCAGATCAACATTACGCAAAAGAATTCTGATTTTCTC
CACCTTGAGAACAGATTAAAAGAAAGACTAAAGATAACACTGTACAAATCCATTTCTTT
TCTTTTCCTTTTTTTTTTTTGAGATGGAGTATTACTCTGTCACCCAGGCTGCAGTGCAG
TGGCGTGATCTCGGCTCACTGCAACCTCTGCCTCCCGGGTTCAAGCAATTCTCCTGCCT
CAGCCTCCTGAGCAGCTGGGATTATGGGTGCATGCCACCACACCCGGGTAATTTTTTGT
ATTTTTAGTAGAGAGAGGGTTTCACCATATTGGCCAGGCTGGTCTTGAACTCCTGACC
TTGTGATCCGCCTACCTCGGCCTCCCAAAGTGCTGGGATTACAGGCGTGAGCCACCACG
CCCGACATGTACAAATCCATCTCTTTACACATCACAGCATAAACCAAATATTGGCCAAG
GTGCAATATTGTTTTTTAATTCTTTATTGCTTTCTTCTAATCTGAATTGATTAGAACAC
AAATTGCAGTTTTAGTTAAACTGGGGACGGGGGACAATGCTTACTAGGAAAGCCAAGTT
TCATGTGGAAAATCCTCCCTCCCCACAAGCACATATCAAGGATGGAGGAAATCCTTCAG
GAGAAACGAGATGCATGTCTGATGCTTAGAGCTGAGGATGGCAGCTCTAAGCTGGATGT
CTCAGCAGGATGGCACCTACAAGCTGAGGTTAAGACACCAGGACACTGGCTGTGTGATG
TCTGGCAACTTACTTGTCTCCATAAGCCTTCGTAATCTCTGTACCTCTGGGAGAACTAA
GCACTCACCTCTCGAGTCCCCGAGGTCAGAAAAAAGGAAACATAACATCTTTGACGGGC
TCTGCGGTCAGCACACGCGCGGTACAGGTGATCTGTTACTGTGATGGCCTAGGGGACTC
ACCTTTTCTTCTGTATTTTGGGGGTTCTTTCCAAGTTCTGCTTGGTGGTGTGAACACCA
CAGGGACACATGCTTCATGAATGAAACCTGGTGTTCGGCATGGGAGGCACCTGTGTCCC
CACCAGAGCTCCAGAGCCACTGTGAACGTGTGGAGATGCTTCCTGGACCAGCCCCTGG
GGCCTGGGGACGCTAACTCTCCTATAATCACATCACAGAGTCATACGAAATGAGAAGCG
TCCCATTCAAATATACCCAAAGTGCCCCCTTTGAGAAACACTGGGTTAGAGCTGGGGGT
TGGCAAATGTTTTCCCAAAGGGCCAAATATCAAGGGACATATAAATGTAACCATTTAGA
AATGTAAAAACTGTTCGAGGCTCTGGCCGTAGAAAAGCTGGCAGCTGCCCGGAACTGGC
CCATGGATGGCAGTTGGGTGACCTCTCATGTTGAACGACATTCAAGTGCGGTCCTGCCC
CTTTAAAAACCTGCTGCTGCTCACAAGGAGCTTGTTCCTGCCTCTGTGGAGCTGCAGGA

Figure 61c

GCCAAGGAGCAGGGCTGCAGGGACCTCACAGAACCAGGCGTGCCTGGGCAGGGCGTACC
TGCTTCCGGTAGGGCGTGATGACGCCAATGTCGCTGGCAGACACCTGACTGGAGATGCT
GTGGGCCAGGAGGCAGCAGTAGCGCAGGACCTGGACGGCCTCGGCCGGGTTGAACCACG
ATGGGCTTTTTCCCTCCCGTGCCTCGCTGCCCTGGGTTGATGAGGAGAGAAAACCTACT
TTACTTCATGAATATTCACCAGAAGGCTACAATCCAGGAGCTGAAGTCGGTGCTGGGAA
TACACACTGAATATGACAGAATAAATCCCTGCTCTCGTGCAGAACTTACATGTGAGCAG
GGCAGATGGCATATGTTAAATGATGAAATGGCTCACAGTCATGCTAAACGCTACAGAGG
AGGACGGGTCACAGGAGTCCGCCACTCAGGTCTGAGCCCCGGAGTGGAGGGCTGGCTGG
TATTTCTGATCTTTTTTTTTTTTTTTTTTTGATATTAGACCTTTGATATAGCTACTTC
TCATCTTGAAAATACTCTTCCTTAGAAAACATTAATGAGATATACTGACATAAAAGACA
GACATATAGATCAACAGGGTAGAACGGAGAACTTAGAAATAAACCCTCGAATATACGGC
CAGATGACTTCTGACAAGGGTGCCAGGACAGTTTTCAACCAACGCTGCTGGAAAAACT
AGAGAGCCACACGGAAAGGATGAAGACGGACCCTCACCTGACACCACCTGGAAACAGAA
ACTCAAGGTGGATCGAAGATTTAAACCCAAGACCTAAATCCATAAAATTCTTGGAGGAA
AACAGGGAAAAAGCCCCACGACATTAGGTTTGGCAATGACTTCTTGGATACGACACCAA
AGCCACTGGCAATAACTAAAAGGGATATGCTGGACTACATCCAAATGGAAAATGTCTGG
GCATCAACGGACGCAATCAACAACGTGAAAAGATAGTCTGCGGAGGGGGGAGAAAACCT
TTGCAAATAGTATATAAGAAGTTAATATCCAAAACTACGAGGAAGTCTTAAATTCACTG
ACAAAAAGCGACCCAATTAAATATGGGCAAAGGACCTGAATTCTCCAAAGGAGACATAC
AAATGGCCAACAGGTACATGAAAAGCTGCTCAATGTCACAAATCATTAGGGAAATGCAA
ATCAAAACTACAGTGAGCTACACCTCACTCCCACTAAGATGGCTACTATAAAACAACCC
AGAAAATAAGTGGTGGTGAGGATGTGGGAAACTGGAACCCTGCGGCACTGTTGGTGGG
GTGTGGAATGCTGCAGTTACTGTGGAAAGCAAGATGATGGTTTCTCAAAAAATTAAGAC
TAGAATTACCAACAATTCCACTTCCGGGTATGTACCCATGACGACTGAAAGCAGGGTCT
CAAATAGATATCTGTACACCCGTTGTAGCAGCACTACTTACAATAGTCAAATGTCTGCA
GCCCAAGTGTCCACTGATAGATGAACTGATACGCCAAGTATGGTGTATACACACAATAC
AATGCTACTCAGCCCCCAAAAGGGAGGAAATTCTGACACACACCACAACATGGATGAAC
CTTGAGGACATGATGCTCAGTGCAATAAGCCGGTCACAGAAGGACAAACACTCCATGAT
TAATTCCACTTGTATGAAGTACCTAGAACACCTGAATTCATACAGTCAGAAAGTAGAAT
GGTGGCTGCTAGGCACTGCAGGGAAGAAAGTTACTGTTTCATGGGTATAGAATTTTAAT
ACTGCAAGATAAAAGTTCTGGAGACTGCAAAACAATGTGAATATACTTAACACTATTAA
ACTTTACACTTAAAAATGGAGTCCAGGCGTGGTGGCTCACGCCTGTAATCCCAGCACTT
TGGGAGGCCGAGGTGGGCAGATCACTTGAGGTCAAGAGTTCGAGACCAGCCTGGCCAAC
ATGGTGAAACCCCGTCTCTACTAAAAATACAAAAATTAGCTGGGCGTGGTGGGGCATGC
CTGTAGTCCCAGCTGCTTGGGAGGCTGAGGCATAAGAACTGCTTGAACATGGGAGGCGG
AGGTTGCAGTGAGCCAAGATCATGCCACTGTACTCCAGCCTGGGTGACAGAGTGAGACA
ACTGTCTAAAAAAAAAAAAAAAGTTTTTAACATGACAAATTTTATATTATGTGTACATTT
ATTTATGAATGAATGAATGAATGAATGAATGAGACAGGGTTTCACTCTGTCGCCCAGAC
TAAAGTGCCAGGGCATGATCACAGTTCACTGCAACCTCAACCTCTCCAGGCTCAGGTGA
TCCTCCCACCTCAGCCTCCTGAGTAGCTGGGACCACAAGTGTGCACCACCATGACCGGA
TAATTTTTGTATTTTTTGTAGAGACAGGGTCTTGCTATGTTGTCCTGGCCGTTCTTGAA
CTCCTGGGCTCAAGCAATCTGCCTGCCTTGGCCTCCCACATCCGGCCCTAGAATTTAAA
AAAGTGACCACCAGGCGGGGTGCGGTGGCTCACGCCTGTAATCCCAGTACTTTGGGAGG
CCAAGGCGGGCAGATCATGACGTCAGGAGTTCGAGACCAGCTGGGCCAACATGGTGAAA
CCCCGTCTCTACTAAAAATACAAAAATTAGCCGGACGTGGTGGCAGGCACCTGTGGTCC
CAGATCCTTGGGAGTCTGAAGCATGAGAATTGCTTGAAACTGGAGGCAGAAGTTGCAG
TGAGCCAAGATTGCACCACTGCACTCCAGCCAGGGTGACAGAACAAAACCCTGTCTCAA
AACAAAACAGATAAACAAAAACCCCAAAAAGTCACCACCAGATAAAGCAGTAAAAATAC

Figure 61d

GAAAATTAGTTGGACGTGGTGGCAGGCGCCTGTAGTCCCAGCTACTTGGGAGGCTGAGG
CACGAGAATCGCTTGAACCTGGAAGGCGGAGGTTGCAGTGAGCCGAGATGGCGCCACTG
CACCCCAGCTGGGTGAAAGAGCAAAACTCTGTCTCAAAAAAAAAAAAAAACCCACAAA
ACAACCCCCAAAAAAGTGACCACCAGATAAAGCAGTAAGAATTAATTTTGCTGTTGTTG
TTAAACCATTAACTTACTCATTTATTGTAAATAATAAGTGACTGAAGAAACTTAAAAGA
TTAATGGGATGGAAACTTATAGCAGAAACTTCTAAACTGAGAAACAATTCAATGAATAG
CAACCAATCAACTAGAAAAAATCAGGAAATAAAATGACTAAGAAAGATAAAGAAGAAAT
CATGTGAAATCACTATAGACTGGGCTGATTTATGTCACTAAAAGCAAACTGACTCCCAA
AATGGATTAAATATAAAAACCTAGCTGCTCCTAAGAAATACAACAATAAAAAATGAAGA
GGGCAAAGACATACCAGGTAAAAAGAAAAAAGTGGCAATGTTAATATTACGAGGTGGAA
TTTAAGACTAATACACATGACAGTATGGAAGGATATTACATAATGAGGAAGATAAAGCA
GTGATAAATTATATGCATGAAACACAGCAGTTAAAATTCGTAAGACAAGAACGATCAGA
AACCCAAGGATAATTTGATGAGGAGCACGACGAGAACGAGGGGCTTCATGACTCTTCTC
CGCCATGGCCTACCAGGTGGACAGATCCTAGGCCAGGACACAGAGCTGCTGAGTGACAG
CCTCCATGCATTTATTTATATTTATTTATATAGTTTTTAGAGTCAGGGTCTCACTCTGT
CGCCTGGGCTGGGGTACAGTGGTGCAATCATAGCTCACTGCAGCCTCAATCTCCTGGGC
TCAAGCAATCCTTCTGCCTCAGCCTCCCAAGTAGCCGGGACCAAAGGCACATGCCACCA
TGCTCAGCTAATTTAAAAAAAAAAAAAATTTTTTTTAAGAGATGGGAGTTTCACTATGT
TGCCCAGGCTAATCTTGAACTCCTAGGCTCAAGCAATCCTCCTGCCTCAGCCTCCCAAA
GTGCTGGGGTTACAGGTGAGCCCCTGTGCCTGGCCACTAATGTGTTTCCTGATACCCA
GGAAAGCTTCTGAGGATGGGCAGAGCTAGCAGGACAGATGGCGGGAGACCACTGCAGGG
GAGGGACCTGCCTCAGAGTGCACCATGTCTGGAGGTGTCCAGCTCACTGCAGATTCTCC
TTAGGACCCCTTCCTTTCCAAATGTGAGAACCTCACAGCCGCCATACACATATCCCATC
CCACCACTTTGGACAGATCACAGACAGATTTTCTCCCTCAGGAACTTACGAAGAGCAAC
TGGGGGCCACTGCTGGGTAGGGCATGGAATGCAGAGGCCCCAAGGCAGCCAAATGGTGT
AACCTGGACCCCTGTCCTCCGGGGCCCGTGGCATGGAAGGGGCACTGGCACCAGGGTTC
CCCGTGTGGCCCGGGTGCAGCCCTCACTGCAGATACCTTGAATGCCCCTTCTTCTGGGG
CAGGGGGTTAATGCAAAACTTGATTTCTGCTCTAACTAAACTCCTAATACAAACTATCT
CATTTTAGCGAATGCTTGTAATTTTGCTTGGTCACTCAGCATCTAACTCTGTCCCTCTG
CGAGGCCTTGGAGAGGGGGTGGTGGCCCGTCACTCCTCAGGCCCCAGGCGCACGGCTCG
GGATCGCAGCTGCTGCCTTCCCTGCCGGGCTCTCTCCTGACAGCTCCAACCCTCGAGGG
AAGCACCGGGAGGGAGGCGGTGGTGGCCTCTGGGAGCTTCCTGCGGCCCTGGGGCGTCC
CCAGCCACATGGCCCTGCGAGCTTCCCCAGGCCCTCCAGAGCTCACTGGGCAGCTTCGC
TTCTCTTGGAGCCCAGTGCTTGTCTGCTGTGACCACCTGAGAGTGGTGCCTGTGATGCC
TCCTTGGTGCCAGGCACAACTCATCTGGCAGGAGAAGTCAGCATCCATCTTGGGGGGCA
CAAGCCCCCGATGGCTTTTCACTCTCTGGAGACCAGCAGAACATCTGCCCCGCCACAGG
CAGGTGACAGAGCCTCACCTGGGAGGAAGGACCTCCTGCCATACTGTCCTTACCCGACA
CGGTCACCTACGGATTCAAGACACAACTCACCCGCACACCATGGAAGATGAGAGGGAAG
CCTTTCTTAGGCAACTTCTCCCAGCCCAGCAAGGAGGTCACCACTGTGGGGTCCGCACA
GACCTCGAGTTCCCTGTGGTAGAACAGCCGTGAGGGCAGCATCAGCAGGGCCTCGTGGG
ACCGGTAGTTCTTCACCAGCTTTGTGACCTGCGAGGAGATGGTGATGGGTCACAAGGGG
AAGGTGGTACCCGGCACAGTTTCTGTCGAACGAAAAGCGGCTCTGCACAGCAAACGTGA
GGCCTGCCTGACTTCCAAGCCTGACTCTGCTCCTGCGCCCCTGTGTGTCGCCTGCCCCC
AGACCAAGCCCTTGGATGATGGTCAAGCCAAGGGTCCATCTGAATAGAAAATGGAAACA
TCAGGAAGAAAAGGGTGTGACGGCTGCCCTCTGTTCCTCTCCTGGGTCTGGGTGCCGCT
GAGGGGCCTCTTAAAGGGCTCCTGCCACCTGGAACCCAGCAGCCGGTGGAGGGCAGGT
GGATGCCTCCCTCGTGTGCTGAGAGCTTCACCCTGGAAACAGCATCTTGTTGGCCCACA
CAGCCCTGCCTCCGCTTGGCCACAGGGAAGGAAGAGCTCCTGGGCCCCTGGGCCAGGAG

Figure 61e

AGCATAGACACTGTGACTCTGGGGCCTGGCCAGCCCTGGGCGGGCCTGGCTGTGACTT
CACTGATGCGGCTGAGGGTGACTGTGATATCACCAGTACATGGGACACCTTTACTGTCT
GCCTCCAACTTGCTCGGGAAGCTCACTCAGGGCAGGTGCTCTTCCCCTGGTGCTGGTGT
AAGCAGCCAGAGAGGGTCTCCAGCGACTACAGGAGTTCAACCAGTCAGAGCAATGCTCA
GTCTTGACCCTGCTCATCACGTGACCCATGTATTGGCATGAGGACTCGCTGCGTCTGTG
CCGCGGGGAGCCGTCCTCTCTATGCAATGCTGCACCCTCTGCCCTCCTGTCACTGACTG
TCCCTCGGGGAGACACTGCTGGGGAGAACAAGCCTAGGGCTCTCCCTCCTTGGGATGAG
TTAACAAAGCCCCTGTTGGTGAAAACCTGTGTTCCTGCAGTGCTGTCTGTTACTCGCCA
GATGACACTGGCACGAGAACGCCATGATTGGCCCCGTGAGTCCTCCCGACTCTGTCAAG
CCTAAATAGAATGTGTCCAGCCTCCAACGTGCTACTCCAAACTCCAAATGTGATCTAGA
GTCACGGCACCTCTGCCTTAGCTGGACATGGGCAGCTGCTGGGGAAGAGAAAGGAAGCA
TGCAGCCTCCTGGGGTCACTGTGGCAGCCGCTCTGGTTGGAGGGTGCAGGACACTGCCC
AGGCCCCACACAGGACAAGGCCTTCACCTCCCGTGCGGCAGGGTCTTTCTGTACCTGTG
GCCCTGTGCTGTATGCACCTGCCCTGAAGGCTGTGTGGTGGGACGGCAGCGTGCTGGT
CTCTCCTGCTGCGGCCACGTCACCTGCACCCACACCTCCAGCAAAGCAGCTAGCGGGTA
CAGGCGCACAGCGGCACTGGAGGATGAGGCGAACCTCCGGGGGACAGCAGAGCTCTCAG
GCGCCCTCTGGGCCCAGCAGCTGCTCACGGCCGGCCATCTTCCTGGGGGCAGTTTCATG
GCCTCCTGGCACAGCCGGTCCTGTCTTGCGGGTAGTCCCTCATGAGGCCTTCCTTGGCC
TGAAGACCCCCACCTGCTCCCTACCCTTGACAACCAAGAATGGGGTCCAGTCCTTTTCC
CTGAAAGTCTGCCCATGGTAACTGCCCCTCATTTTCTATTGATGTTAATACTGGCAATG
GGAATCAGATGGAGACTGTTTTTCTGTGGGCTACAGGGGCTTACAAACTGAGGCTACTT
GGTTCACTGTTGAATGATGGGCCCTGGAGGCCCAAGCTCAGTGTGCTGGGGGCTCCAAA
GATGCAAATCCCAAAGCCCATCCCTCAGAATTTGGTGCAAGGTTGGCTGAGAGCCCAGA
CCTGCACTTCAGTGGGACCTTGGGGTCAGAGACCACTGAGGAGACACTGCCTGCAGTCA
CTCTAGGGCAGGCTTTTTAAGTCACAAAAATTATTTCTTGCTTTTCTTAACGTTAACAG
AGTAACACAGATTTTAACTTATTTTACTGAATCTGACCCCAGAGTCTCAGCCATCAGCA
CCAGGCTGCAGTTTCTGCTGACGGGGGAGGTGCTATGGTGGGTGCTCCCCTGCACTCTG
CCCACGGATGGAGATGACTCAGGTGGACAGAAGAGTGAGCTGCTCGACTGCCCTGGAGC
CTGTGTCTGCTTAGCTGGGGACCTGAACGCGCTGGAGTCTGTGACTCACCAACAGGGGA
TTATGTGCGCCACAAGCACCGAAAGCATTTTCGTCCCTCTGGTACGCGGGTCGAGACAT
CAGCCGTTCCAAAAAGGACACGTTCAGCCCATAGGCCATGGCGAGTCTGGACTTAATGA
CTGGGCCGAGCTGCATGGGGTCTCCTGCCAGCACGATCTGCACACAGAGGGCCCGTCTC
AGCTCATGCAGGGAGGGTGCCGCTGCCACTCCTACGGGCTCAGGTGGGAATGGGGCTGT
GCGCAGGATGGCCCCATGCTCACTCTTGCTGCAGGGGACGACGGAGGGACTGGGAGAC
CAGGGAATGCCGACAGGGCTTGGAGCCGTCTCTCCCCGCTTCCCCCTGAAGTCCTGCCA
TCTGCCTCCCCGAAGTCCTGCCATCTGCCCGGCTTCTGCAGCCTGGTTTTCTCTCCTGC
GAATCTCTCAAAGTGGTAAGAGCCCCAAGGATGCCGTCTATCTTCTGGAAGCTTCTGCA
TGGCTGGCCCTGGCCGCCATCCCACCTGCCCCTTGCCTCTTGCCCATGGTTGCCTTGAC
CTGGTCAGGCCGCCCTATGCCGCTGCTCTGCCTGGACCAGTCCCTGCTCCCTCCCTAGG
CGTCACCTTCATGCTCCGCCCCACAGTGCCTGGTGACTGGGACAGACATCTAGGATGGG
TGCCAAGGAGGACCCTGAAATGTCCAGTGCTGGACACTGGATGAGCTCGCCTGGATGAG
CCACAGTGAGAGAACCAGGGAAGTTCAAGGTGATGCCCACGCCACCATCAGAAGCACTC
GGGGAGGAAGCAGGTGGGAGCAGAGAACAGAGGATGCACAGAGCTGGAGGCCAGGGCAG
CCTGAGGGGCAAGTGGGTCAGATGCAGGAGCACTGGCCCTGTCCGCCCCTCCAGGCACT
GAACGGCCGGCTCACCCAGAGCAGGGACCACATTCCTGACTTTACCGCTGTATCCCCAA
CACCTAGAATGGCTCTTACCTCCGTTTTACAAGTAAATGAGTCAAGACATTCACTTCTA
GTCCAAAAGGAATAAAGTACAATAGAGACCCATGGCCCCCAACACCTCGGGGTCCTTGG
CACTTCCACCTGACCCCTGTACAGCTGTGACTGTTCCCGGCAGGATCGCAGCCTGCATC

Figure 61f

CCCTCAGGAGAACGGGGTGAGGAGGAAGCAGCACACACAGTAGTCCGGACTTACCTGGC
CACTGATGTCCGACATCAGCCCCAGAGGAATGAGGCATTCCGGCTCACTTGCCTGCCCA
GCCTCGTCCACAAACACGTGAGTGAAGTGCCCAACTCTAGAGCAAAGATGTTCTAAATG
GTAATTTCTGCCGAATTGTTTTAGCAATTGATGCCTCTGACACACTGGCAAAGCCACGC
TCAGCACCCCGGGGGCACAGCAGGGTTGCCCAGGGGTGTGCAGGAGCTGGGGGTCTGGG
TGTCACCCGGCTGGAGGGAGGACAGGCCACAGGTGTCAGGAGATGCTAAGCCACATCAG
CACCCAGTGCTTTGCACGCAGCGTCTGTATTTCTAGAGATGTGGAGGGAAGAAGGGGTG
GGAGCGATGGGCAACACACGAGCGCCTCCTGGGGGCAGCTCACAGGAGAAGCGCCGCAG
GCTCCTGGCCTGCTCTCCACCTGCGTCTCACTCCTGTCATTATCAAAATGCCCAGGCTC
TAGTCCTGACTTCCCCTCTCTGAGCCTCCACCTCCCACGTGTCTCTCGGGAGGTGGCTG
AGGTGAGAGCAGCTGAACTGGCCGCTGTAAAGCGCTGAGAACAGGCCTGGCCATGCAGG
CGGCCACAGATGGCAGCCTCTCCTGCCATCCGCTCATTTCCTCCTGACTCATCCTTGTG
AGCCACTCTCAGCTGGGCACTGCCTGGCCTGCATGCCAATAGGCTGAGGCCCTGGGAGC
CACTTCCCAATCTGCGGCACCATTAAGAAAATGGGGTTGGTCGGGCGCAGTGGCTCACG
CCTGTAATGCCAGCACTTTGGGAGGCCGAGATGGGTGGATCACGAGGTCAGGAGATCAA
GACCATCCTGGCTAACACGGTGAAACCCCGTCTCTACTCAAAATACAAAAAAATTAGCC
GGGTGTGGTGGCGGGCGCCTGTAGTCCCAGCTACTCGGGAAGCTGAGGCAGGAGAATGG
CGTGAACCTGGGAGGCGGAGCTTGCAGTGAGCTGAGATCGCGCCACTGCACTCCAGCTT
GGGTGACAGAGCAAGACTCCATCTCATAAAAAAAAAAAAAAAAGAAAAAAAGAAAATGC
GGTCTCTAGAATGGCTCCCCACAATTCTGGCCCCTGCTGCAAACTCAGTGAGGTTCCCA
GCTACAGAGCAGCCCTCCTGGCGGGTACCTGTCCGGCTCTTCCTTCTCCGTGTGACAAG
GGAGGTAAGGGAGGTGCAGGAGCAGAGAGTCCACAGCGTTGCTGATGGACGGGGTGGGG
ATTTTGCGGGAAGGAGTCGTCAGGAGAAGCTGCGGAACTCTTGCATGGGAAGGCTGTGG
GACTGAGCGGAGAGCAGGAGCTCGCTCGGCACATGATCTGTTTCTAGAGTGCAGAGGGG
CCACCCCACCTGGGGCCATGAGCTGAGGAACAGGTGCCCCGGCTTCCCTGGCTCGCCCA
CCCCAGCAGCTTCTGCTCTGTGGTCAGGAGGCCTCAGTGGGGAAATGCTCTTGGGGCAG
AAACATGTCCTGATGCCTGAGGAAGCAGGTATGGGGCAGAGAGAGTGTCCGGAGCCACG
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CATCACCTCTGAGCCTCAGGTGTCCCACTGTGGGGTGAGACCCTGTGGTCAGACCTGTG
CGGGGGCGGGCTCCTGCTTACAGCAGTGCTGGGCCCAACATGTCCTGCATCCACTCACG
GTCAGCTGACACCTTTCACTTCAGGTATCAATGTGTAACTCTCAAGACACGGATTTCAC
AAGTGACACCGTGAACCCCTCCCAGTGAAAGATGTGGAAATCAGCAAACTGCCATTTCC
CCATCTCATGTCCCTATTTCTGTTGAAAAAAATTAACATTATGTATCTTTCCTAGAATG
TAAGTATTTAGGTTTCAATTCTGTATTAATTGCAGTTATTTAATGTCACTTTTGCCAGA
TGACATTGCTACTTCTTTGCCCTTTGAAGTGCCCCTCCCCACTCCAGCCGCCCCCAGTG
GCCAACTAACGCTGTGGGGCCTCTGCAGCTGGGCTGCAGCACCCTCCCTGCTTCTGCAC
AGAGCGCCTCTGAGAGAGCGGCCTGCAGCACCCTCCCTGCTTCTGCACAGAGCGCCTCT
GAGAGAGCGGCCTGCAGCACCCTCCCTGCTTCTGCACAGAGCGCCTCTGAGAGAGCGGC
CTGCAGCACCCTCCCTGCTTCTGCACAGAGCGCCTCTGAGAGAGCGGCCTGCAGCACCC
TCCCTGCTTCTGCACAGAGCGCCTCTGAGAGAGCGGCCTGCAGCACCCTCCCTGCTTCT
GCACAGAGCGCCTCTGAGAGAGCGGCCTGCAGCACCCTCCCTGCTTCTGCACAGAGCGC
CTCTGAGAGAGCGGCCTGCAGCACCCTCCCTGCTTCTGCACAGAGCGCCTCTGAGAGAG
CGGCCTGCAGCACCCTCCCTGCTTCTGCACAGAGTGCCTCTGAGAGAGCGGCCTGCCCT
GGCCGGCCACCTCCTCCCACTACCTGAACATCAGCTCCAGGGTGCAGGGTCCATGCAGT
GCCCGCTCTGCCCCCAAAGAGCCCTCTGCACCCCAGTGAGGACTGGCTCTTCGGCTCTT
GACCTTTGACTCATCAACACACATTAACAAAAAAAATCCCTGTCTTGTTCAGATCCGTG
CTGTCCAATCCGGTAGCCACACACGGCTCTCGGGCACCGCACAGTGGCTAGTCTGAAAC

Figure 61g

CTGACATGCTCTAAGTGTAAAATACATGGTGGATTTTGAAGACTTGAACCAAAAAAAAT
GTAAAGTGTCTCATCAATCACGTTCTACTAATCTCATGATGAAAGGACATCATGTATGT
GAGAGAGTTAAACGCGCCGATGAAACCATCCGTGACACGCTGTGATAGGCGTGGCTGGC
TGTGCCTTTGCTCCATGTGGAGCTGACGGACCACCTCCTGTGGTCACCCTCACGACCAC
CGTGACGCTGGACACTGTCCAGGGTGACCTGTCTCCAGGCTGTCAGGGAGGGTCACGAC
CACTGTGACGCTGGACACTGTTCAGAGCGACCTGTCTCCAGGCCGTCAGGGAGGGTGGG
GCTTCCCTCAGAGGCCCTGGCTTCTCCCTCTCTCACCCTCAGCCTGTGCCCCCGACACT
GTCTGGCTCTATGCACTGAGAGGGAGCTGCCTGCTGCCTCCCCGACCCCACCCCCCTGC
ACTGGGGTCTGAGAGTGCCTTGGTCCTCACTCAGCCTCCCTGGGCTCGAAGCTCTTCCT
CCCAGCCCCCAGGGGAGGTCCTCCTATGACAGCCGGCACCCCACAATCCATCTCCTCCG
CCTGTCTCCCCTGAAGAGCCCCCAGCGCCAGGGACACAAATGGCCCCCAGGGTCTGACC
TTACAGAGCCCAGCCGTTTCCTAGGCAGCCTGCCTCCCCACGCCCACTCCAAGAGACTC
ACTCTCCTGCTCAGAAGCCCTTCACTGGCTTCCCGGCTCACCAGAGGTCGTCCAAAGGC
CCCTCCACAGCCCGCCAGGCCTCCCCCTCACCACCCCTTTCAGGCCGTTCCTGCTCACG
AGGCTCTGGCTCTACAGTCTCCTTTGGGGAGACCTCAGTGCTCCCCCACCGCGGGGCCT
CTGCATGGGCCAGTCCATCTGCCTGCCCATCCCACTGCTGGCTCCTTCGAGTCCTTGGG
GTCTCGGCTTCCCCAGCTCCATTCAGGCACGGCCCTCCCCAACCAGCCTTTCTCGCCCA
CAGCCCTGCCTCCCTCCCTGAGCACTGAGTCTCTGGGTCATCCGCCCCTCAGACAGAAG
CTAGGAGAGGACTCCGACCTCTGCCCTGGGAGGCCCCATGCCGCGCTCCATGCCCGGGG
CTCACCTCACTCCTATTTGGTAAAACAGCCCTGAGCTGCTGCATGTGGTGATGATTATC
CGGAAGCGTGAGGCTTTCCAGATGTCTTCTCCGTCTCTGCAATACGGTTTGACGGCGTC
AATAACTATCTGGGGGCAAGGAGGCGTAGAGTTAGTTTACTCCTCCAATTATTAAGCAG
AATTCCAAAAGGGAACCTTGCCCTGGTACCACTTCTTAGTTACGTCTAAGTCATGATTT
AAGGTTTTTTTCTCAAAATATCTCATACTTCCTTATCAATTCAGTCCATGTTTTATCAA
CTCTAGAGCCACAAATATAACACATAATCCTGCAGACCCTTCCCCAAAACAACTTTGTA
CATTTTCTATTCAGTTTGTTTGTTTGTTTATTTAGAGAGGGAGTCTTGCTCTTGCTCTG
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TTCAAGTGATTCTCCTGCTTCGGCCTCCGGAGTAGCTGGGATTACAGGCGCATGCCACC
ACGCCCAGCTATTTTCAATGTCTTTTTAAACGCAATATTTCAGGCTGGGCACAGTGGC
TAAAGCCTGTAATCTCAACACTTTGGGAGGCAGAGGCGGGTGGATCACTTGAGATCAGG
AGTTCGTGACCAGCCTGACCAACATGGTGAAACCCTGTCTCTACTAAAAATACAAAATT
AGCTGGATGTGGTGGCACACACCTGTAATCCTAGGTACTTAGGAGGCTGAGGCAGGAGA
ATTGCTTGAACCCGGGAGGCGGAGGTTGCAGTTAGCCAAGATCACACCACTGCACTCCA
GCCTGGGCAACAAGAGCAAAAACTCTGTCTCAAACAAACAAAAAAATAAAAGCAATACT
TCGCTCTATAACCAAACCAGCAACTTAAAGGAATACTTAAAACCAAACCAGGCCGGGCA
CGGTGGCTCACGCCTGTAATCCCAGCACTTTGGGAGGCCGAGGCGGGCAGATCATGAGG
TCAGGAGATCGAGACCATCCTGGCTAACACGGTGAAACTCCGTCTCTACTAAAAATACA
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CCAGAGAATGGTGTGAACCTGGGAGGCGGAGCTTGCAGTGAGCCGAGATCATGCCACTG
CACTTCAGCCTGGGCGACACAGCGAGACTCCGTCTCAAAAAAAAAAAACAAAACAAAAC
AAAAAACACCAAACCAACAAAACAAAACTACTTAAAAAGTAACAAGACGTTTGGGGATT
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ACTCACACAGAGTGAGAATGTGATGAAATAGTCAGCAATCAAGCTCCACCATTTAGCGG
TGAGGGAGGGCCCATGGCAGAGCCATTTCTCAAACACAGCTTTCTGTGGCGCCTCTGTG
CCCACCCTCCTACCCCTGCCCTCCCCTGTCCACTTGGCATTTCCTATGTTCCAGGGAGG
GGTTCTGGTGCCCCCCACTGCTTGCACCAAGGGCTCACCTCCTCGAACCTGCAGGTGGC
GTTCACCCGGACCATGGTGGCCGGCTGTAGCACCTTGCTCTCGTGCAGCCGCAGACACA
CGAGGTCAGCAGCACTGTTGGAGGGCGCACAGACTAAAATCCGACTGTCCGGCAAGGCA

Figure 61h

AAGTGTACCTTCATCAAAGACACACAAGAGACCAAGGCTCAACATCCACACCGCAAGGT
GGAAACCAGGAGTCTAACCTCAACACACACATTCGGGTGCAGGGACTCAGCTGCATGGG
CTCAGATGCCAGCCCCCAACACACTGAGACCTGGGCCACGACTCTGCCTCATCACACTG
CTGCCAAAGCATGGGTTAGGTGGGAAGGTTCTCCGCACTCTCTAAGATTCTAAACCACC
TTTCAGGGCAGAAACAGAGTCAGATTCATCTGCACACATCTGGCGTGTGGTACAATTGT
GCGCTCAATACCTGTTTGCTAATTTGAATCCTGAATGACGCTAAATGTAGATGGTCTTC
GGCTTATGATGGTTTGACTTAACGCTTTTTTGACTTTATGATGGTGTGAAGACCATCCC
CAGTCAGTCTGCTCCTCACCTGACAAGGGATCATGCCTTGATGAACCTGAAACAGGCTT
CCCAAATCCCATTACGATGGGTTATTGGGTTGTAACCCCATCAAAAGTTAAGAAGCATC
TGTAGACAATAGTTTCATAAACTTAACTTCAATTACAAATGAAGATATCTAAAACTTCT
GTGGAATGGTGGCTGTAGCTACTATAAGAGTAACTTCTTTTCTGCAGCAAAATGTCATG
ATTCAGATAAAATAGTTTACCAGGCTAAAAATGAGTTTCCTTCTAAACCTATGAAATAA
GCTTTTAAATCCCTACATATCCACAAAAACAGACTTAACATTATGAAATAACTGGTATT
TCTCAAGCTCTTTCCAACTGTCTGATTCTACAATCTAAACTCACACTTCCTGAAGACAC
AGACGACACATGAACAGCAGCACAGAGCCACAGCACCCGCGGCGCCGCTGTCCTTACCT
GTAAAACAGCCTCTATTATTGTCACTGTCTTTCCAGTACCAGGAGGTCCAAAGAGAATA
TACGGGAGGGGACGGCAGTCACCACTCAGAATCCTTTTAACTGCTAACTTCTGATTTTC
ATTTAGCACTGGGTTGAAAAACTCCATCTTTCTTGCTTTAGGGGTCTGAATTTCATCTA
CTGTATTCAAAGTGAAGAAAGTTTCAGTTAGATGCAAACAGCTCTCAACAGCTGTGGAC
ACGTCCTCACCTAGGTCAGGCGTCAGCACGTCTGTGCAAAGGCTAAATCAGAGTCACAG
ACAGGGAGTAGCTCTTCAGTGTGACCAGGGGTAAGATGCGCACAGGGCATTCCTCTTAA
TAATCTGTTTGCATTTTTTTTTTCTTTTTTGAGACAGGGTCTCGCTCTGTCACCCAGCT
TGGAGTACAGTGGCACAATCTCAGCTCACTGTAACCTCCATCTCCTGAGCTCAAGCGAT
CCTCCCACGTCAGCCTCCCGGGTAGCTGGGACCACAGGCGCCCACCACCACACCTGGCT
AATTTTTGTATTTTTTTTTTTTTTATAGAGACAAGGTTTCGCCATGTTGTCCAGGTTGGT
CTCGAACTCCTGAGCTCATATGATCTGCCCACCTTAGCTTCCCAAAAGTGTTAGGATGA
CAGGTGTGAGCCCTGCACTCAACCTGTCTGTGCTTTGTTAAAGAGGGTCAGGAGAACGA
ATGCAGCTGCTGAGAGGAAAATGACAGGCTGTCAACCGATTCTGCGGCTTTAGAGATCA
CACTCAAATATTAGAGACTGGATTAAAAAATGTCCACATCTGCAGAGTACCTGGAAAAA
AACAACCCAGAATCTAAAAGTCTTCTTAAAGTATCTAAGCTAAAACACCAAGTCTCCAG
TCAGGGTGGAGACGGCAGCCGCCTGTCACAGGCCACACGCCCCCTACTGTTCTTCCTTC
TGCATGAGAGCCCACTCCTCAAAGTCCCCGTTTTCCAGGCGACAGTCTCAGAGTTGCTC
TTCTCCTTGCCCCTCATGAGCACATACCCCAATCGCTCATCTCTGCAGTAAAGGGTGCC
AGCACCGGCAGGTCCTTGTCACCAACACGCCTCTCCTCTGTTCCATGCTCAGCTTGGTC
CGTCATTGTTTTCCTATTCTAGAAATTATCAGGCAGAAAAATGTTTTAAAAAAACAGCT
GTGTTTACACTGGCTTGGTTGAAAGAGCAAACGTAAACATCTAGTGTTCTACTTAGTAT
ATTTATTTAACAGCTCTTTGGATGGATCACAGGTCAGACCCTTTGAAAAATAAAGAAAA
AACAAACGATCAGATAAAAAACTGCTAAAAAAGTTTGTGCTTTTTTCTTTAAACTTGCT
TTTAGAAATAAACTAAAATTTGTGATGAAACCAAAGCACAGGACTAAATTTTATTTTAT
TAATATCATCTTCCCTTGGTACATCCTACCTGCTTTCCAGGCTGGACAGTGGGGGAACC
TGCAGGGGACAGTCAAGGGTACAGCCCAGGGCTCTGGGTCTCACGGGCCTGGAGAGTGT
GCAAAGTGCCAGTGCTGCCTGTTGACGTCAGGCAAGATCCTGCACCAGGCCGGGCACGG
GGCTCACGCTTATCATCCCACCACTGTGGGAGGCCAAGACAGGTGGATCACTTGAGCCG
AGGAGTTTAAGACTAGCCTGGCAACATGGTGAAACCCTGTTTCTAGCAAAAATACAAA
AAAAAAAAAAAAATTAGCCGGGCATGGTGGTGCTCACCTGTGGTCCCAGCTACTTGGCA
GGCTGAGGTGGGAGGATCACTTGAGCCCAGGAGGCGGGGCTGCAGTGAGTGGAGATTGG
GCGACCAACTCCAACCTGGGTGACAGAGACCCCCCAAACTCATAAAAAAAAAAAAGGCT
GCACGCAGTGGCTCACGCCTATAATCCCAGCACTTTGGGAGGCTGAGGCGGGCAGATCA

Figure 61i

CAAGGTCAAGAGATCGAGACCATCCTGGCCAACATGGTGAAACCCTGTCTTTACTAAAA
ATACAAAAATTAGCTGGCCGTGGTGCCACCAGCTACTCGGGAGGCTGAGGCAGGAGAAT
AGCTTGAACCCGGGAGGTGGAGGCTGCAGTGAGCCAAGATCGTGCCACTGCACTCCAGC
CTGGCGACAGAGCGAGACTCTGTCTCAAAACAAAAAAAAAAAAGGATCCTACACAAGAA
TTGGTTTTCTGTGTGTTCCAATGTAAGTAGTATTTGTCCTGAACCAGTGGGATTTTCAA
TTTTTTTCATTATGATCTGTAATTCTTTGTTAAATAACTTCATTATTTTCATAGGATAG
ATTCTGGAATCTATAAAATCAAAAGTTCTGGGGCCAGGGGTAGTGGTTCACACCTATAA
TCTGAGCACTTCAGGAGGCTGAGGTGGAAGGACTGCTAGAGTCCAGGAGGTCAAGGTTG
CAGTGAGCCATGATTGCGACACTACACTGCAGTTAGGAGGACAGAGGAAGACTCTGTCT
CAAAAAAAAAAAGTTTCACGTTAAAAAATTTACACACATTGCTAAGTTTTAGTCTAAAA
CAGGCTTGTCCAACCAGCGGCCCATGGACTATATACAGCCTAGGATGGCTCTGAATGCA
ACCCAACACAAACTCGTAAACTTTTTAAAACACTATAAGATTTTTTTGTGATACATATT
TTTTTCAGCTCATCAGCTATCATTAGTGTTAGTGAATTTTATGTGTGGCCCAAGACAAT
TCTTCTTGCAACGTGGCCTAGGGAAGCCAAAAGATTGGACACCCATGGTCTAGAAGGTT
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AGGTGCACATATTTAAAGTGTGTGACTTGACAAGTCTGACGTGCACATACCCATAAAAC
CATCAGCACAATCAAGATGACAAATAGACCTGTCAGTCCCCAGAGCCGCCTTGTGCCGC
AGCCCCTCCAGTGGCACTGGCTGGCTCACATGCTCTCGAACTTCATACTTCATATAAAT
GCACACAGTGTGATTCATTGGAGAGCCACCTGTGTTGTTGCATGTCAACAGTTTGCTCC
TTGTATTGCTGAGTCATGTTCCATTGTACGAACACAATGCAACTTGCTTATCCATTCAC
CTGCTCACGGACACTGGGTTGTTTCGTTTTTGGTGATTAAAAACCCAGCTGCTGTGAAC
TTTGTGTATGGGTCCTCACGTGGCCTTATGTCTTCATCTCTCTAGAGAGAAATGGCTGG
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TTCTTTGTTTTTTTTTGAGACAGAGTTTTTCTATGTTGCCCAGGCTAGCCTGGAACTCC
TGGGCTCAAGAGATCCTCCAGCCTCAGTCTCCTGGGTCACTGGGACTAAAAGTGTATGC
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GTCCAATTTATCCATTTCTCTGTAAGTCATGCTCTTAGTGTCACATAAAAAAAAATCCT
TGCCCAAACAGAGGACGTGCAGATGTTCTTCTATGCTGTTTCCTAGATGCATAGTTTTA
GGCTTGACATTGCGGCTATAAACCGCAGAGTAAGTTAGTTTTTGTCTGCGCTGTGAGCT
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CCAGCACTATGGGAGGCTGAGGTGGGCGGATCATGAGGTCAGGAGTTTGAGACCAGCCT
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CACGCACCTATAATCCCAGCTACTCAGGAGGCCGAGGCAGGAGAACTGCTTGAATCTGG
GAGGCGGAGGTTGCAGTGAGCCGAGATCCGCCACTGCACCTCGGCCTGGGCAACAGAGC
GAGACTGTCTCAAAACAAACAAACAAAACACCAAAAAACAATTTCTGAGTGTTTACTGG
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GTTCTAACAGCTTCATTTTAGATTCCATCAGATTTTTTTCTTTTCTATTTTTTTTTTT
TGAGACAGGGTTTCACTTCATCACTCAGGCTGGAGTGTAGTGGTACAATCACAGCTCAC
TGCAGCCTCAACCTCCCAGGCTCAAGGATCCTCTTGCCTCAGCCTCCTGAGTAGCTGG

Figure 61j

GACTACAGGTGTGTGCCACCATGCCCAGCTAATTTTTAAACTTTTTAAAAATAGAGACA
GGGTCTTGCATGTTGCCCAGGCTGTTCTCAGTGATTTTCCCATCTCAGCCTCCCAAAGT
GCTGGAATTACCGGCACGAGTCACCACACCCGGCCTCCATCAGACTTTCTACAGGATGC
GGATGCCTGTTCTTTCTGCTTCATTGCCTGTCTACAATGCACAATGCTGGGCAGAAATG
CTGAGGAAACATGCCCTGATCCTGATCTTACAAGCAAAGAACATTCAGTTATCACTAAG
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GAATGGATGCTGGATTTTGTCAGATGCTTTTTCCAAGTCTACTGCCATGATTATATGGT
TTTTCCTTTTCAGTTTGTTAATATGGTATATTACACATTTATTTTTGGAATGTTAAGCC
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TTTTTTTTCTGGGATGGAGTCTTGCTGTATTCTATTGCCCACGCTGGAGTGCAGTGGCG
CGATCTCGGCTCACTGCAGCCTCCGCCTCTGTTCCATGTTAGATAGTTTCTATTGCTCC
GTCTTCAAGTTCACTAATTTTTCCTTCTGCATTGTCTAGTCTGCTGATAATTCTGTCCA
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ACATATTTATAACTGTTTTAATGTCCTTGTCTGCTAATTCCACCATGTTATTTCGGGGG
GGTTGGTTCCAATTGACTAAATTTTCTCCTTTTGGGTTACGTTTTTCACTTTTTCATTT
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CTCTGTCCCCTGCCCTCTCCCCAGCACTCTACTCTGTCAGCTTTATCCCCCTTGTCCTC
CCCACCCTTCCAAATGCTGTCTCTGTACTCAGGTCACTGCACTCCGCCTGGGCTCCCTC
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TGGTCCCTGAAATTCTATCTTGGTTGACATATGAAATATTCTTGAGTTTATTTTCAATC
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TGCCCACCTAAATAGTAACACCTCCCTGATCTCACATGCCATCTGCACCACAGACTCTC
CCCGAGAATCAGGCAGTAGAATGAACCAGTAATGAGGTGATGACGGAGAAGAAAAGCAC
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CAGGCTGGAGTGCAGTGGCGTGATCTCGGCTCACTGCAACCTCTGCCTCCTGGGTTCAA
GTGATTCTCCTGCCTCAGCCTCCTGAGTAGCTGGGATTACAGGTGTACACCATCATGCC

Figure 61k

CGGCTAATTTTTGGATTTTTAGTAGAGATGGGGTTTCACCATCTTGGCCAGGCTGGTCT
TGAACTCCTGATCTCATGATCTGCCCGCCTCGGCCTCCCAAAGTGCTGGGATTACAGGC
GTGAGCCACTGCGACCGGCCTAGAAGTTTTTATAAAATATCTTTGCAACATTCACAAAG
TTTGCAAATGTTAACAATTTGCGGGGTGTGTATCCTTCCAGACATTTTCCATGCATACA
CAATCACATAAATGTACCTAAGTGTACACATAAACCATATAATTTAAAAATAAAACTCT
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GGATCACAAGATCAGGAGATCGAGACCAGCCTGACCAATATGGTGAAACCCTGTTTCTA
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AGACAGTCACGCCGCTGAGCCACCCCCTATGTAAAGACAGCCACGTCGCTGAGCCATCC
CCTGTGTAGAGAAAGCCACATTGCTGAGCACTACCTTTTTGCTGGTGGACTGTCCACTG
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CCCAGGCTGGAATGAGTAGCGTGATCTCGGCTCACTGCAACCTCCGCCTCCTGGGTTCA
AGCAATTCTCCTGCCTCAGCCTCCCAAGTAGCTGGGATTACAGGTGACCACTACCACGC
CCGGCTGATTATTTGTATTTTTAGTAGAGATGGGGTTTCCCCATGTGGCTAGACTGGT
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Figure 61l

AGGTGTGAACCACCACACCCAACCTAAAACTGTCATTCTTTGAATCAATGATTATATAT
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CCCCCAGCTTCGTATGGTGAAACTTCATCCCCAATGTGATGTTACTGGGTATGAGGAGT
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CCCATTCCTGGGTCTTCTCATGGCACTCACATGCTGGGGTCTCTCATCTTGCACAGCAA
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GCCTCAGCCTCCCAAGTAGCTGGGACTGCAGGCATGTGCCATCATGCCCACTAAGTTTT
GTATTTTTAGTAGAGACAGTGTTTCCCCATGTTGGCCAGGCTGGTCTCGAACTCCTGAC
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TCAAAAGATACTTTTTAAAAAGCTAAAAGATAAGGAAGAAATCTGGAGAAGATATGTAC

Figure 61m

CTAAGAATAGTTTATCATAAGGAATACAGAAAGGACTCCCACAACAATGAAAATTGGAT
AAATTACTCAATAAAAAAGAGGGCAAAAGACGCAAGCAAGCATTTCATGGAAGAGGAAC
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AACAAAATCAGATTACAGAAAGGGCACCGATCAGCAGGCTGTTATACACATGGATACTG
AAAGTCACTGATGCAACCACTTGTAAAGCTGGAAAAACCCCAAACCCAGCAATCCCATC
CCTACATACACAGCAGCTCTAGGAACAGCAGCAAACAATCGTAACAGCAAACAATGAAG
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TACAACAACACGGAGACATCTCAGGAACACAATGTTTAGTGAAAATCTCGACTCCTAGG
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CATTTTTTGTGCATGACTAGTTAATGGTTTTGTGGAGGAAGAAAAAGCCAGCTGGGTGC
CAGGTCACAGCACCCCTCATCCGACAAGAAAACAAATAAAAGTAAGGAGCTGGTAGCTG
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ACATGCAAATGTATGCACCTTTATATCTCAAAAAATAGTTGATAATAAAGCTAGAAACA
CGGGGTATGCAAAAATGCTGTAGGAGCCCACTTCCATCCACAAGGCCTATACACGTCAA
CCACAGGCATGGTGGGGGCTCCTACGTCACTACTTAGATGTCAACAGACATACTCAAGA
GAACACTGTCCAATTAAAGATAAAGAGACAAATTAACTGGGCATGGTGCCTCATACCTA
TACTCCCAAAACTTTGGGAGGCTGACGCAGGAGGATCGCTTGAGCCTAGGAGTTTATGA
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CGCCTGTAATCCCAGCACTTTGGGAGGCCAAGGCAAGCGTATCACAAGGTCAGGAGTTC
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GGAGGCTAAGATGGTCATTCGGCCATCTTGGGCTCCTCATGTCAACTTGGTCAACAGCA

Figure 61n

AAGGTGGGTAATGGAGAGCTGGCGAGGTCATGTCACTCGTGTCTCACATCTCAGTCCAC
AGGCGATGGCCTAATTCATTACAAAATCTCTGAAATCCTGCCAAGATGTTGTCTTCTGG
GAAATATCCCACTCTGTGAAATCAGCCACAGCATGGACCCTGCATGAAGGTGTAGCGCA
GAGTGACTGTGGCATCAAAGGTCGGAAGCTGCCTCTTCTCCAGATCCTTATCAGGCTCT
TCTAGTTCTCTCAGCCCTTCTTCCTTCTGACAGTAAAGGCTCTGGCATTCTCCCTTCAA
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GTCCAGCCCAAGAGTCACAGACCACCCCATGCAGAACCATCTGGAGCACCAGGATCTAC
TCAAAGCCAAAAAAACCACCTTCACGCAAACATCAGAGCTGCAAACTCATAGGTGTATT
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ACAACTCAACGCAAACCTCATGACTTACATATAACCTAAAAGATAAATATGTTTTACAT
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GCATATTCAAGAATCCCAATGAACCCCAAGCACAAGAACAGGAAGAAAAGAATCTCTAC
CACCACACATCGTAAACCAAATCTATTAATATCAGTGATAAAAGAGAGAATCTTAAAAG
CAGCTAAGAAAAAACAACGTTATGTGCAAAAGAGCAAAGATAAGAATTAAAGCAAAAGA
ACCCCATAAGAAAAACTAAAAAATACTTAGGAGATGAATAAAAACAAAAACACAATACA

Figure 61o

GCAAGACTTATGGGAGCAGCACAAGCAGTGCTGAGGGAATTTGTGACTATGAGCACTGA
TTCCCATGAGCACTGCAAGGAATTAGACAAAGGAGAACAAACTAAACCCAAAGATAGCA
GAAGGAAGGAAATAAAGATTAGAGGAGAGATGAACAAAAGAGAGAACTGAAAAACAATA
CAGAAAACCAGGAAAACAAAAAGTTGGTTCTCCAAAAAGATCAACAAAATTGACAGACT
TTTAGTAGATTAACTAGAAAAAAGGGAAAGACAAATTACTAAAATAAGATAGGAAAGTG
GGAACATTACTACAGAATCTACGGAAATAAAAAGGATTATAAGAGTATGAGCAATCGTA
TACCAATACCCAGATGAAATGGACAAATTCCTAGAAACACAAAACCTACCAAGACTAAA
CCATGAAGAAAGAAAATCTGAATAGACCAATTACTACTAAGGAGGTTAAAGCAGTAATA
AATATTCTGAAAAGGAAAACCCCAGGACCTGATGGCTCCATAGCTAAATTCTACCAAAC
ATTTGAAGACTAACTAATACCAATCTTTCTCAAACTTTTCCAAAAAATTCAAGAGGAGG
GAATACTCTCTGACTTATTCTTATGAGGCCAGCATTACCCTGATCCCAAAGCCAGACAG
AGACACTTCAGGAAAAGAAAACTACAGACCAATATGAACACTGATGAAAAAATCCTCAA
CACGATACTAGCACACAAAATTCAGCAGCATATGAAAAGGATTAGCTGGGTGTGGTGGC
TCATTCCTGTAGTCCCAGTTACTTGGGAGACTGAGGTGGGAGGATTGCTTGAGCCCAGG
AGCTCGAGGCTGCAGTGAGCAGTGACTGAGCCATTGCACTCCAGCCTGGGCAACACAGT
GAGACCCTGTCTCAAAAAACATATATAAAATAAAAGGATTACATGCTATGATCAAGTGG
AATTTATTCCTGGAATGCAAGGATAGTTCAACATTTGAAAATCAATTACTGTAGCAACA
CACATTAACAGAAGGAAAAAAAATCATATGATCATCTCAATACAGAAAAAGCAATTGAA
TTTTTTTTTTTTTTTTTTTTGAGACATGAGTTTCCCTCTGTCACCAAGGCTGGAGCG
CAATGGTGCGATCTCAGCTCACCGCAACCTCTGCCTCTTGGGCTCAAGCGCCTCCCAGG
TAGCTGGGATTACAGGTGCATGCCATCACACCCAGCTAGCATCTGACAAAATTTAACAC
CCTTTCATGATAACGTTTAACAAACTAGGAAGAGAAGAAAATCAGGCTGGGTGTGGTGG
CTCACACCCATACTTGCCTGTAATTCCAACACTTTGGGAGGCCAAGGCGGGAGGATTGT
AAGACCCTGTCTCTATGATATACAAAAGTTAGCCGGGCATGGTGGTGTGCCGCTGCAGT
CACAGCTGTGAGCTGTGATTGCGCCACTGCACTCCAGCCTGGGCGACAGGAGAGCCTGT
CTCAAAAATAAATAAATAAATAAATAAATAAAAAAGAGAAAAAGGAAAAGAAGAAAAAG
AAAGAAAGAAAGAAAGAAAGAAAACCATCACCTCAAAATGATGAAAGTCATATATGAAA
AACCCACTGTTAACATCATACTCAATGGTGAAAGATTGAAAGCTTTTCCCATAAGATCA
GGAACTTCCAAGGGAAGGATGCCTGCTTTCACCACTGCTATTCATCATGGTACTAGAAG
TTCTAGCCAGAGCAATTAGGCAAGAAAAGGAAATGAAAGGCATCTAAATTGGAAAGGAA
GAAATAAAATTATCTGTTTGCAGATGGCATGCATAATTTTATATGTAGAAAACTCTAAA
AGATTCCACAAAAAACTGTTAGAATAAATAAATTCAGCAAAGTAGCAGGGTACAAAATC
AAAGGACAAAAATTATCTTCATTTCTAAACAACACTGAAGAATCTGAAAAGGCAGCTAT
GAGAGCAATGTATTTACAACAGCAGCAAAAATAATAAAATACTTACAAATTAATTTAAC
CAAAGAAGTGAAAAACATATACAGAGAAAATGACAAAACACTGCTGTAAGAAATTAAAG
AAGACATAAATAAATGTTAACACATTCCATGTTCATAGCCTGGAGGATTCAATATTGTT
AAAATGTCCATACTAACCAACGCAATCTACAGATTCAATGCAATTCCCATCAAAATTCC
AATGACAGGCCGGGTGCAGTGGCTCACACCTGTAATCCCAAGCACTTTGGGAGGCTGAG
GCGGGAGGAATACTTGAGGCCAGGAGTTTGAGACCAGCCTGGGCAATGTAGTGAGACCT
CGTCTCTGGGGAAAAAAAATTCCAATGCTATATTTTGCAGAAATAGAAAAATGCATCTT
AAAATTCGTATAAAAGATCTTGAAAAGCAAAATAAATTCTGCCAAAGAACAACAAAGCT
GGAGGACTCAAATTTCCTGATTTCAAAACTTACTACAAAGCTGCAGCATCAAAACATCA
AGTCGGTGGCCTGTGGAAGGAACTGAGGAGCACCCTCCAAGCCCAGCAGACCTGGGTCC
CCAGGGAGGAGCTGAGGAGCACCTCTCCATCCTAGCAGACCCAGGTCCAGCTTTTTCTG
CCACCTCGATGAACCATTCAGGCATTTGCCTACAAACTCAAAGTGACTGGGGGACAGAG
GACTGCGCTCGCGACTCATGGCAACCTCCCTGCCCAGGATCTGTGAGTAAAACACATCT
GAACTTGTTTCTATCACGGCAGTGGATTGAATTTGCACCTTCCATCCTAAGAACCCAGC
ACTGCCCAGGCCGGGTTTTCCCTGGCATTGGGGAACATAAGTTTGGGCTCCCAGTGCCA

Figure 61p

GATGATCAGGCAGGCATAACCTGGATACAGGTCAGACGAGAGCCACTGGGGCGTCTGCC
AGAATAAGTTTCCTGCGTGAGGAACCCCGGTCATGGGGCATCAGCTGTCCTCCTGGTAA
AACAAGGACATTTTTTTAAACAAGGAGGTGTATTTGGAAAGGATCCCCTGAAGGGCGCA
TGGTGAACACCTAGGTCCCATTCCCTTCATTCTCCTTAGGACAGGGCTGCCAGCTGCTC
TGGCACTGGAACTCCAGTTTAGCTGGGGACTCTCAGAACACCTCAAACCCCTACAGAAA
AAAACCCTCCTGGACAAAGGGCAATGTTCTCCCCTCAAACTGCCAAATTTATAGACTTT
TCTTCCTTCTTGAACTTTTCTTCTCCACCTACCCCACTCAGAACGTGCTCCTCTGTCTC
CCATGTGGGTGGGGACCTGGGCTCTCCTCCCCTGGACCCTTGCCCTGCTGGCTCTGTCA
GGATGATGGTAAAAGGCTAGAACACTTCTTGCTCATAACAAAGGCCTCCTAGTCTAGCG
AGAGAGGCCAGGCTGATGGCAGAGGTATCCCTCAGTTCTTCTGCTCCAGACCCCAAAGG
CCCTGTGCGTGACCCCCAGTGAGGCTGTGGGATGCCAGCCCCTGGTGTACAGCAGGTCT
GGCAGCGTGAGTGCTATGGTGCCTCATCCCTCACGGCCAGGCAGTGACCCTCGTTATCC
CAGCTACCTGTGAAGAAAACAAGCCAGATGAAGGTCTGAACCTGAGAAGGAACCTCCTG
GCTTTGTCAGAAAACAAGAGCATTAGAAGATGCCAACACCCCACAGGCCATGAGACACT
TCCTACCTCTGCAAGTAATGGCTGGAAAGTCAGGATGTCAATTTTTTGTTCCACACATT
TTCTAAGTCTATCTGGGATTGGATATTGGGGAAGAAAACTTGGAAGTTGTCGTCTTGAG
TTCCTTAAAAAATTAAGTTCACAAGTTAAAAATAAGTCTTTATCACCAGGTATCACTAG
ACATTCTTACCTAAACATCCTTTCCTATTTAGGAAGACCAAAGTCCATCCATTTCCTG
AGAAGAACTGATATATGAATAGCTGGTCTAAGGCAGTGGTTTGAAGCTTTCGTTTTAGC
TCTGGGATCCTTTCCTCAAACAGTTCCCACAAGTGCTCTACTATTTGTAAACAGGTAAG
TGTAGCTGCACAGGCTGTGGGAAAACAGGGCTGGAACCCCCAGAATCTCCTGGAACCAG
GAGTTTGGAAACAGCTGTTTTTAACATTCTATGAGCTAAGCTCTTCCTACTATATTTGA
CATCAGGACTCCACCTGGGCCTATCCCTGCAAAGCACACATTAGGAAAAGGCTGCTCTG
TCTGGGTCCTGCCTTCGATTTGTTTTTGTTTTGTTTCCCAGCCTGTGGTTTCTCTGGGG
AAATTCAGTTTGTTCAGGATGAAGAACATCGCTGCTCTGGAGCCAAGCCCAATGCGGCA
ACAGAAACAATGGGAAAGGGACAGACAGGAGAGGAGAAGCCAGGAGAGAACAGGGAAAC
GAAAAGTCAGAGTGAGGTCGATAAAACTCAACTCAGCAAATAAGGATGTTGGTTGGACC
TTTATCCCTCATTCCCTCCCAGCTCTCCATTTCAGTGCAGTCTCACCCAAGAGAGAAGC
CCACATTGCTCTCCGTATTCCATTCACTGTCATCTCAATTTGGGTTCCACTGGCTCAGC
CCTCAACAGGAGAAACGGGGTGAAGACATTCCCCATGGTTTGTGCTGAGGGTTATGTCA
GCGCTCACATGCGAGGTGTATTTGGAAAGCATTGATTACTAACACGAACAAGGTAAAGG
GAAACCAGGATGATCACTACAGGCTTAGGTCAACAGCCTGAACAGCTAACAGAACCATG
TGGCCTCAACAGACACGCTGGATTAACAAAATGTGGTTCCTACCATGATGGGTGGCTAG
AAACTTGGCTGGGAGTGTGCTGGCCTACAAAGCCCCCCAGAACAGATCTGCTAAGTGAA
CACTCTGCTCTAGCTAAGAGCCAAAGTTGCCTGGCACTGGGGGTCCTAGCAGGAAGTGC
AGGACCTGTGACAGGCGGCCACGGATGGACAGCTCTGGAAGCAGGCACCCGCCAATGCC
CGCGTGGGCAGGTCCAGACACCTGGTGCTCCAGGTGTGCTCGAGCCAACCCGGGTCAGG
CACTCTGGGTCACTAACCTGAGTGGCAGGAAACTGATGTCCTTGTTTTAGATACGCTCC
CACACAATATGTTAATATTCACGGGGAAGTAACTGACCAGGGGGTTAAAATCCTTGTGG
CTGTTGCTCTGTGTATTTCACTCTTTCTGTTAAGCCAAATGATAACTAGAAAGCTGCTT
GGTGTGTCACTAGATGAGAACCAGGGATCCTCCAAGGCTCCTGTCATTAAAACTCGATC
CTCGGGGACTCTGCTCTGCCTGGCAGCCGAGGGACTTTCCTGCTCCTTTTCTGGGTTAC
ATCCCTACAGCCCCTTGATGTTGAAACTGTGCCCCAAAGAGTTAAAGAAACCGATGACT
AACAGAAATTCTTGAGCCTGCAGGATGGGTGATAAGAAACAACTCCAGCGCTGAGTCTC
CCCCTGCTTATGACATCAAAGGACTGGCTGAGATCAGCTGGAACCAAGATGGACAACTG
GAGTTTGTGCAGAGCTTACTGACGTCACAGCCTGGATTCCCACCGTGTTTCATGCGAAC
TCCCTCCGAACTGGCACATGTGACCCATGAGGTAGCATGAAGGGGTAACTATGCACACC
CAAGGCCTTTCCAGACCTCCCTTTTCCTTCCACCAACCACCTATTAATCCCAGATTCTA

Figure 61q

CCCACTAAACGTTTTCTGACAAAATTACTGCCTTAAAGCCAGCACAGAGAGACACATTT
GAGCTTGACTCCTGTCTCCTTGGGGGTTGGTTTTCAATACAAAGCTTTTCTTTTCTCAG
AAACCCACTGTCGTAGCAATGGCCCCTAGTGCATCAGGCAGTGAGCCCCTTTTTCTCAA
TAATAATATGCCCAGGGATCATGACTGCTTATTCGCTTACTGAGTGATTGCTTTGTGCC
AGAAAACTGCACATTTTACATGTCTGACCTCATTCAATCTTCAAACCACACGAGGCAGG
GACTATCATTTTACCAATGAGAACAAGGCTCAGAGTGGTTAAGAAACTTGCCCAAGGTC
ACACAGCTTCTTGGTGGTGGTGCTGTGATTCAAACAATGGTCTAACCTTAAAAGGTAAA
CAACCACATGATATTCTTCCCTGGTAACAGGTTTTCCCTTTAGTCTGCAACTAAGTAGA
AGTCCATAATCCCTCATCTTGAACTGTAACTGGGGCAACACGTGATTTGAAATTCAGAA
TCTTTCAGTATTAGAAAAGTGACCCACCTCACCCTCAGGGAGGTCTGGGGTAGTAGCAG
AGCTCAAACCCATCAGTTATTATAGCCGATGGAGGAAAAGTCACATCACACGGGACTAA
GTCATTACACTTTAAAAAGCCTGCTATTCAGGGCTTTTTCGTTTTATAACTACAGAAGA
GAACACGTGGATGTGAAGTGCTTTCCTGAGACTACCCTCCAGTTAAAATCTGGGTGGTC
CCTATGTTCCCCAGCCACAAGTCCCAGATCACACACTGCTTCTCCTAACTCCATTCTTA
AGTGGTACCACATCTTCAAACAGGCTTCAGGTGACCCCACAATCCTGTTGCCCCCAGTG
CGAATGACACGGGGATGCCGTGCACTACACACCATGGCCTCGTCAGGACGGGAGAGGTG
GCAGGAGCTGGGTGAGGCCAGCCTGCTCTGAGAGCCACCTTGGAACTGCCAGAGCAGAG
TGGGGCTTGGGGGAGTGAAGGCCGTCTTCCTTGGGCTTCACGCTGCTGCTGGGCAGCTG
CAGAGACAGAACTTGACCTTCAGAGCTCCGTGGAAATGCACTCCATCCCCCAAATACAA
TCATGGAAAGAGGCTTGAACCCCAGCTTCATCCCCTTTATACCTCCCCAGCCAGGTGGT
AGCCACCGCTTGCCAGTGCACGTCCGCTTTTCCTTCACAGATAAAACTGCCAGACCAAG
AGCCACACTCATTTCAGTTATGGTACCTTTTCTGTGCGGTCACAACAACTGTAGTTTTT
GCGGATGTTAACGCTTGTGAACTTTTAAGCTTTTTCCAAGAAAATGGTTCGCGCGCAGC
AATTAGTGACTCCTCCCCACTGATAACATTTACTTCAAGGTATCGCCCAATTAGGAAAT
CGGAAAAACAGAGCAAAAGGAGCTCCTTGCAGCGGCCAGGATTTCTTGAAAAAAACAAA
ATGAAATTTAGTTTTAGTCATAAATAAGATAGGCAGTCAACACAATTTTCCTTTGTACA
TACAAGAAAAGTGACAGAGTTAAGACTCATCTTTAGTCTTCAATAATTCTTTTTACAGA
GAAAAAAGAGATCTTCTAAAATAAGCTATGTAATTAATATTTTCTCAAGATAAAATTAA
GCACCTACAGGCCCGGTGCGGTGGCTCAGGCCTGTAATCCCAGCACTTTGGAAGACTGA
GGCGGGCAGATCGCTTGAGCCCAGGAGTTTGAGACCAGCCTGGGCAATATAGGATGAAC
CTGTCTCTGCAAAAAATACACAAATTAGCCGGACATGGAGGCGTGTGCCTGTGGTTCCA
GCTACTCGGGAGGCTGAGGTGGGAGCCTAGGGAGGTGGAGGCTGCAGTGAGCTGTGATC
ATGCCTCTGCACTCCAGCCTGGGCAACAGAGTGAGACCCTGTCTCAAAAAAAAAAAAAA
AAAAAAAAAGTAAGCATCTACAATAGTCTTTTTTGTAATCCTAACACATATAAGAGTAG
GAAAAAATTTTGATATTCCCAATTTTAAGTCAGAATTTTATGACATGACCAAAAATAGG
TACTATATCTAATGTGCTTTCTGCCCAGTCCTCGCTGTGGCTCTAACTGGGGCTACATC
ATCCACACTACACTTTGTGCCCCCCTATGGCTTTTTTTTTTTTTTTGAGACGGAGTCTC
GCTCTGTCACCCAGCCTGGAGTGCGGTGGCGTGATCTCGGCTCACTGCAAGCTCCGCCT
CCCAGGTTCACGCCATTCTCCTGCCTCAGCCTCCTGAGTAGCTGGGACTACAGGTGCCC
GCCACCACGCCCAGCTAATTTTTTTTATTTTTAGTAGAGACAGGGTTTCACTGTGTTAG
CACCTATGGCTTTTTTGAAAAAACCTGTTTCTATGTTGTCATAATGTCAAAAAAAAAAA
AAAAGCATTGAAGCTGGCTGCACCTCACACAGCTGACTGTGCACTTGCCACCCACAGCT
TGATGTTGATGAGCTGTGATTTAATCAGATTTAAGTTTTTCAAAAAATTTAGAATTAGA
CACCCAGCTGGAAGGCTATCACGCACTGTCGGCAGCTTAGGCAGGGATGCAGGGACAC
AGGGAGCTGGAGGACAGGGCCTGTTTGGTCAGCTGATGTAACCAACCACACCAGGGAGA
GCGAAGGGCTCAAGGTTGGCGTCTGGCATCCCAGCTAGGAAGGGGCCCTTCCTGCCCCT
CCCTCAGCACACTGTGCTGTCCGTGCCTTGGCCAAATGCCCAGGTGACGGGATGGAGAT
GACCGAGGCCCCAGGGCTTGGCTATGCGGAACACGGGCAAGGCAGTGAAGAGGAGCCAA

Figure 61r

CGTGATGTCTCAGAACAGCAGAAGCACAGGGAGCTCAGGCCTCAGAGAGCCTCAGAGAC
ACCCTGTTTTCTTTGTGAGGGTGAGAGGCCATCTGGTGAGGACCCTCATGAGTCGTGCG
AAGTTACAGGATCCATTGCCCCAGGTGGGTCACACTTGGTACCCAGCTTCTAGACCAAT
GCTTTTTCTTAGGATTCTGTCACATCAAAAACGTCAGGTGTACCTTTTTGTTTTTTTGA
GACAGAGTCTTGCTCCGTCTCAGGCTGGAGTGCAGTCGTGCGATCTTGGCTCACTGCAC
CCTCCGTCACCTGGATTTAAGCGATTCTACTGCCTCAGCCTCCTGAGTAGCTAGGACTA
CAGGGGCCCAAGTAATTTTTGTATTTTTAGTAGAGGCGGGGTTTCGCCATGGTGGCCAG
GCTGGTTTCGAACTCCTGGTCTCAGGTGATCCACCCGCCACAAAGGAGTACCTTTTATA
ACACCCAACCTAGAAGTATCAGAGAAACTTAAAAACGCGGCTCTCCCCAGACCTCCAGG
CCCTTACTTTCCGTCACAGATGACCACAATGAAGGTTTTTCCCCCTGGAGGGACAAGCC
CCCCAGGCTCAGGCTCTGTCATCTGCTTCCTTGATAGAATGTTGTCTTTTTCTCCATTT
TCTCCTTTACAGGTACAATCACCTGGGAAATAAAATTTTAATACAAAAGTTGACCAAAA
GGTAAATTATCTCTAACAGTGCTGGCATGCTTAGTGGAAATGAATACTCTCTCACACAC
ACAAAGACAGATGCACACAAAAACACGGGGCAAAGCCTCAGGTGGTGGCTGGAAAAACA
TAAAGAGAGAGAGCAGCTGGAAGTAGGAGAGGGCTGTGACTACCAAGTGCTGGGATAGA
AGGCCTGCCCCGGCGCGCCCAGCAATCTTTCCCTGCTTCGAGGTACTCAGGAGCCGGCC
GCCATCTGAAGCACCTCTTGGTATTTGTCAAGCTGCTTTTTGTCCCTCTCCCTAACGTC
GTCAGCAAGAGAAGGGCCTGAAGCCGAAGAGCTCAGAGCACAAAGCACTGTAGCTGCCG
GGTGTCCTGGCCCCTGCTGCCCGCCCTCTGTCCAGAACTCACAACCCCACGGCCCCCAG
CCCACCCGACCTCACGCAGTGACAGCCGAAACGTCCACTACCTGGAGAGATTCCTCTGT
TGTTCACCAAACTGCTCTCCGACATCTGAGAGGTTTTGTTTTTTGTGTGGCTATTTAAT
GAATTAATATTTTCATCTGATGAATTCTCCTTCTCAGGAACAGAAACAAAAGATACCAC
GGGGCACATCTGGTCTTTATCCAGCATTTGGAATCTGAATTGTTTAGATTTATCCCAGC
CAGCCAGTTTACAGCTGACTAAGTTTTGAGGAATGTCTCCTTTATTCCTGGAAAAATAC
AATTAACTATGAACACAGCCAGGATTTCTAAAACCAAAATATTCAGTTATCATAAAACA
CAAAACCTAATCTAGGAAGTGGTGACTGCAAATACACTTATGAATATAAGTCAAAAGGT
CATTTTTGGGTAAAAAATTTTGAAAAGATCTTCATGCCGGGCGTGGTGTCTCACGCCTG
TAGTCCCAGCACTTTGGGAGGCTGAGGCGGCAAATCACAAGGTCAGGAGCTCCAGACCA
TCCTGGCTAACACGGTGAAACCCCGTCTCTACTAAAAATACAAAAAATTAGCCGGGCGT
GGTGGCGGGCGCCTGTAGTCCCAGCTACTCGGGAGGCTGAGGCAGGAGAATGGTGTGAA
CCCGGGAGGCGGAGCTTGCAGTGAGCTGAGATCGCGCCACTGCACTCCAGCCCGGGCGA
CGGAGCAAGACGCTGTCTCAAAAAAAAAAAAAAAAAAAAAAAAAGAAAAGATCTTCATAA
AGAAAAAAATAAATGACCAAAGTAAAGTTGGTTTTACAGAAATTATTGAGTCATAGTGT
AAAAGCCATTAATGTAGCTTTATAGAAAATGTTTCAGTGGCAAACTCACTCTATCCAGA
TCACCATGGTTTTACTTCTTCCTTCCTTTAGGGTTCCAAAATGCGTCACCTGTGTAACT
TCAATATCACCTTTGTTCTTCAGCAAAATCGTTCCATAGAAATGAGTGGCCTCATGAAC
AGGGGCGGCGTCTCTGAAAAAAGAGCCCCAGAAAGACATCCCTCTGCAGCAGCACCACC
CCTTCCTCGCCTGCCTCCGCTCCTGAGGATAGACTGCTGGTGGGGGCACTCAGAGGACC
ACCTCACCACAGGCAGGGCTTCCACAGACTTAGGTTTCTAAGGAGGATGGCAAACCCTA
AGGAAGAGAACGATGCACTTCATAAAGTCTAGAGAAAAGGGAGCAGCCCAGGGGACAGC
CACAGGCAAGGAGTCTGAGAACGGTGTCCTGAACGTGCTCCCCAGCACTCCCCTACCTC
CTGCTCAGAGTGCAGGGTTAGGGTGGCATTCTCAGTCCTCTTCTCTCCAGCCAACTCCC
AAGGTGGTGGTGGGGGAAGCATGGGCCTTGCCTATTAGGGCTCCACTAAACTTGCTTTG
GAAAGAGTTTTGTTGCTTTGAAGTGTTTGAAAACAATGAAATGAGAAGTTTTTCTCTTT
AGAAAATGAGAAGATGAGATTTTACCTTTCCCTAAAAATGGACCCACTTACTTCCCCTT
CTTCTACTGATGCTACAGGCTTGATTCTCCTCCCTGCCTCTCCACAACCTCTTTCCAGA
AGGTAAACCTGCCTCATGCCACTTCCCAGTCCGAAGCACCATTAAAAAAATGGGGTCTC
TAGAATGGCTCGCCACACTTCTGGCCCCTGCTGCAAACTCAGTGAGGTTCCCAGCTACA

Figure 61s

GAGCAGCCCCTCCTGGCGGGTGCCTGTTTGGCTCTTCCTTCTCTGTGTGCCCTGGTGTG
ACAAGGGAGGTACAGGGGCAGAGAGTCCACAGCGTTGCTGATGGACGGGGTGGGGATTT
TGCAGAAAGGAGTCGTCAGATGCGACTGCCCGGTGCGTGGCTCAGCCCCCACAGGAGAA
GCTGCGGAGCTCTTGCCACGGGAAGGCTGTGGGGCTGAGTGGAGAGCAGGAGCTCGCTT
GGCACATGATCTGTTTCTAGAGTGCAGAGGGGCTGCCCCACCCGGGGCCACGAGCTGAG
GAACAGGCACCCCAGCTTCCCTGGCTCACCCACCCCAGCAGCTTCTACTCTGTGGTCAG
GAGGCCTCAGTGGGGAAATGCTGTGGGGGCAGAAACAGGTCTTTTTCAAGCATTACTAG
CCTAAAGAGAAGGAGAGTGCGGGTTCCGTGCTGTGCTGTCTCCTTAGCGGCCCTAGTGA
GTTCCTGAAGACCCCCAGGCCACGCTTCAGGCCCCTGGTTCCTGGGCCTGATGCAAGAA
TGGGACGCCACAGCTTCTGCCTGGGGATGAGGTCAGAGAACAGACAGGAAGCCTGAGGA
GTCCGACTCAGACATAGGGAGGAGGTGCAGGTCTTATTTCCTGGCACCGCCAGGCTCAG
CGGACTGGGCTGAAAGCAGAGCTCCTGTGCGTCCCAGGCTTCCGTGGTCAGATGCAGCG
GGAGCAGTGCACGTCACATCCACGCCCCACAGGATGGGCCCTAGGCACCCCTCCCAAAGG
AAAGCGTGGTCCAGTGGGGAGGGGGAACTGGGCTCCGAGCACCCAAACAAGCATCTGCC
AGTGGGCCGAAGGGCAAGGCTCCTAGGAGGCTGAGCCCACCAGGCCCTGTCCCATAACA
CCTCCCACAGCCCCAAGTCCACCCTCCGGCTGCTACCTTACATGGGGTGCACTGCTCCG
CACACCCCTGTGGCTCAGTTCACACAGGGCTGTCTGTCTGCACCCAGAGGCCCAGCCAG
GCACCAGATATGGGGCTGGAAAGCAGACGCTTTCCCCAAACAGAACCTGCATTCTATCG
GGATCAAAAATAAGCAGACTGATGGAGGAGATGTCTCAGAAGCTCACTGGTGGTGAGTG
AGGAGTGTGAAAAGAAAATAAAGACTCGGGGCCGGGCGTGGTGGCTCACGCCTGTAATC
CCAGCAGTTTGGGAGGCTGAGGTGGGCGGATCATGAGGTCAGGAGATTGAGACCATCCT
GGCTAACACGGTGAAACCCCGTCTCTATTAAAAATACAAAAAATTAGCCAGGCATGGTG
GCAGGTGCCTATAGTCCCAGCTACTCAGGAGGCTGAGGTGGGTGAATGGCGTGAACCCA
GGAGGTGGAACTTGCAGTGAGCAGAGATCGCGCCACTGCACTCCAACCTGGGTGACGGA
GCGAGACTCCATCTCAACGTCTCAAAAAAAAAAAAAAAAAAAAAAAAAAAGCAAAGACA
GAGTCGGGACCCCACTCACCATGCCAAAAGGAAAAAACTCAGCCAGAAGCTGTCATGAA
AGAAGCTGCCTTTCCTTTGTCCCCAAGCAGAGAGCTACAAGACAAGGTTAAACATCTCC
ATGTTACCTTCTCTTACATCAAAGTGCTGATTTACACAACCAACTCTCCCTCCCTGTTC
CTTTTCCTTTCCTCTTGCAAATGTGTATTCAGTCATGTGACCGCACCCTCTTTCTCCTC
CAGCCCACTTTTCTCTTTTAAATATTGAAGGCCTCAAAATCATCTTTGGAAAAAGGCAT
GAACCACAGATGGTTCCTGTGGATTTGTGGTCCTTTTTCCCAGGCATGTCCTTCACCTT
GGCAAAGTGAACTTCTAACTTGATTGAGACCTGTCTCACATACCTTTTGGTTACAGGAG
GAAAGGCAGGCAGGGAGGGGGTGGGTCAGAGCTGGGGCTGCCCCACAAGTAGGGAGCTC
AGGGAAGCCTCGTCATGGCTAGCACACAAAGAAGAACACAGATACAGGAAATCTAATAA
TTTTTTTTTTTAATTGGAGATGGAGTCTGGCTCTGTTACCCAGGCTGGAGTGCAGTGGC
GTGATCTCTGCTCACTGCAACTTCTGCTTCCCGGGTTCAAGCAATTCTCCTGCCTCAGC
CTCCAGAGTAGCTGGGATTAAGGGTGTGCGCTGCCACGCCTGGCTAATTTTTTGTATTT
TAGTAGAGATGGGGTTTCACCGTGTTGCCCAGGCTGTTCTCGAACTCCTGAGCTCAGGC
AATCCGCCCGCCTTGGCCTCCCAAAGTCCTAGGATTACAGGCGTGAGCCACTGTGGCCA
GCCAGAAATCCAATAATTTTAAGAACCAACTACATCCAATGCATTTTTTAAATGCCAAA
ATGTGAAACAACAAAACAGAAAAATCCACCCAAAACAGCAATCACCAATGTAAGATGAA
GGATGAAGAGCGACCCCTAACTCCACCTTCAGTCAACCATAGAGATGGCTGAAAGCTTC
CAAAAGACAGTCTTTTTTTTTTTTTGAGATGGAGTGTCACTCTGTTGTGCAGGCTGGA
GTGCAGTGGCGCGATCTCGGCTCACTGCAAGCTCCGCTTCCTGGGTTCACGCCATTCTC
CTGCCTCAGCCTCCCGAGTAGCTGGGACTACAGGCGCCGGCCACCACGCCTGGCTAATT
TTTTGTGTTTTTAGTAGAGATGGGGTTTCACCATGTTAGCCAGGATGGTTTCAATCTCC
CGACCTTGTGATCCACCCACCTCGGCCTCCCAAAGTGCTGGTATTACGGGCGTGAGCCA
CCGCGCCCGGCAAGACAGTCTTCTTTTTTTGAGACAGAGTCTTCCTCTGTCACCCAGG

Figure 61t

CTGGAGTGCAGTGGTGCAATCTCGCCTCACTGCAACCTCTGCCTCTTGGGTTCAAGTGA
TTCTCTTGCCTCAGCCTCCCAAGTAGCTGGGATTACAGGTGCCTGCCACCACAACCGGG
TAATTTTTGTATTTTTAGTAGAGACAGGGTTTCTTCATATTGGCCAGGCTGGTCTCGAA
CTCCTGACCTCATGATCTACCCGCCTCAGCATCCCAAAGCGTTGGGATTACAGGCGTGA
GCCACCATGACCAGCCTCCTTTTCCTTTCTCTTTTTATTTTTTAAGACAGAGCCTTGCT
GTGTTGCCCAGGCTAGAGTGCGGTAGCACGATCACAGCTCGCTGCAGCCTCAAGCTCCT
AGGCTCAAGCAATCTTCCTGCTTCAACCTCGTGTGTAGCTGGGACCGGAGGTGCACACC
ACCATGCTCGGCTAATTTTTTTTTTTTTTTTTTTTGAGAAGGAGTCTCGCTCTGTCG
CCCAGGCTGGAGTGCAGTGGCGCGATCTCGGCTCACTGCAAGCTCCACCTCCCGGGTTC
ACGCCATTCTCTTGCCTCAGCCTCCCAAGCAGCCGGGACTACAGGTGCCCGTCACCACG
CCCGGCTAATTTTTTGTATTTTTTAGTAGACACGGGGTTTCACCGTGTTAGCCAGGAT
GGTCTCGATCCCCTGACCTCATGATTCACCCGCCTCGGCCTCCCAGAGTGCTGAGATTA
CAGGCGTGAGCCACCGTGCCCGGCCTCGCTTGGCTAATTTTTTAATGTTTTGTAGAGAT
GGGGTCTCACTATGTTGCCCAGGCTGGTCTCAAATTCCTGGGCTCAGGCAATTCTCCTG
CCACGGCCTCCTGAAGTGCTAGGGATGCTCTCCTCTTACCCCAACAACTCAGGGCTTGA
AATGTCTACTATTTGGCTTATTAAAGTAACTCTTCAAAATATACTTATATGGGGCCTTT
CACATCCCAAAGAAGAAAAGCGTTTTCTTTTTTTGAGACGGAGTTTTACTTGTCGCCCA
GGCCTGAGTGCAGTGGCGCAATCTCAGCTCACTGCAACCTCTGCCTCTCAGGTTCAAGC
AATTTTCCTGCCTCAGCCTCCCGAGTAGCTGGGATTACAGGCGAGCACCACCACGCCCA
GCTAATTTTGTACTTTTAGTAGAGACAGAGTTTCACCACGTTGGTCAGGCTGGTCTTGA
ACTCCCAACCTCAGGTGATCCGTCTGCCTCAGCCTCCCAAAGTGCTAGGATTACAGGCG
TTAGCCACCGCACCTGGCCAGAAAAGCATTTTCTTACCGCCTCTTCACTAGGGTCATAC
AAAGTGCCCTCCAGACATAGCATGACTGGCTGCTCTCCACCACCACTGCATTGACCACG
TCACCTCTCCGGGGTGTGTACCCATCTGGCAGTTTCAAGGAGTCCAAGGTAAAGAAGAT
GCTTTCCTCTAACACCCCGTTCCTTCCACAGAGGCTAGAGATGCAGACCTGGGAGCAGA
GAGCTGAGCGTCACAGGAAGCAGATGCTGCATGACGACAGGGCGCAGCTCTAACACACG
CCCAAGTCAGCCCAAAGCACACAAGCTGCACCAGGAAGCTCAAGTCCGCCATCCCGTAG
CACTGGTCCAGTGATTCTCCAACACACCTTTCTCCTTAGAACATTTTAGCACTGTTGCA
TAAGCTACAGACCTTAGAATTCAGGTATGCAAGCACTAGGAGTTATTGTTTCCAAACGA
AACACAGCATTGTCAATAGGAAAACACACTCCTCTTTGGCCATGACAAAGCTTTATTTT
TCCAGGCTTCCAACACATGCAGGAGAAGCCTGGGCCGTGCAAGTTACCCCTGATGGCAG
GTCTGCCAGAAGCACAGAGAGGAGCCACTAGTCGGCACGCTACCTTGTCCACGCGCTTG
TATCTCAGTGGCTTCACTGAGGTGGCTTCGCTGCTCCACGTGCCAGGCCGGATCCGGTA
CTCAGCCTCCACCCAGTCTCCCTTGCAGGGCTCGAAGCCT

Figure 62

SEQ ID NO.:62 hSPG18 cDNA sequence

ccccataccgcgaactttgtagctggtgccttcggaatatgATGGCAAATCACCTTGTA
AAGCCTGATAATAGAAATTGCAAGAGGCCAAGAGAATTGGAGTCTCCAGTGCCAGATAG
TCCACAGCTGTCCTCTCTTGGAAAATCAGATTCATCTTTCTCTGAAATTTCCGGACTAT
TTTATAAAGATGAAGCCTTGGAGAAAGATTTAAATGATGTGAGCAAGGAAATTAATCTA
ATGTTGTCTACCTATGCAAAGCTTTTAAGTGAGAGAGCAGCAGTAGATGCATCTTACAT
TGATGAGATAGATGAACTCTTCAAAGAAGCCAATGCTATTGAAAACTTTCTAATACAAA
AAAGAGAGTTCCTGCGACAGAGGTTTACAGTGATTGCAAACACATTACACAGATAAaat
atatacttgaaataagctgagaatttaacctattattgttataatgaaagaatgacatt
tatgctttgaaagctctcgagttgtt

SEQ ID NO.:63 hSPG18 encoded protein sequence Figure 63a

Figure 63b

MANHLVKPDNRNCKRPRELESPVPDSPQLSSLGKSDSSFSEISGLFYKDEALEKDLNDV
SKEINLMLSTYAKLLSERAAVDASYIDEIDELFKEANAIENFLIQKREFLRQRFTVIAN
TLHR

SEQ ID NO.:64 hSPG25 cDNA sequence Figure 64a

CTTCAAGATTATCAATAATCGGAGATACGTATATTTTATTGTAAAGAAAACATGGCTG
CCCTATTCCTACGTGGTTTGTCCAAATAGGGAACTGCAAGACTGGGATATCTAAGTCA
AAAGAAGCATTCATTGAAGCAGTGGAAAGAAAGAAGAAAGATAGACTGGTGCTGTATTT
CAAAAGTGGAAAATATAGCACTTTTCGGCTAAGTGATAATATTCAAAATGTAGTCCTTA
AATCCTATAGAGGAAACCAAAATCACCTGCATTTAACTTTACAAAATAATAATGGCTTG
TTTATTGAAGGATTATCCTCCACAGATGCTGAACAATTGAAGATATTCTTGGACAGAGT
TCATCAAAACGAGGTTCAGCCACCTGTGAGACCTGGTAAGGGTGGGAGTGTCTTTTCTA
GCACAACACAGAAGGAAATCAACAAAACTTCATTCCACAAAGTTGATGAGAAATCAAGT
AGCAAATCTTTTGAGATAGCAAAAGGAAGTGGGACAGGTGTCCTTCAGAGGATGCCTTT
GCTTACATCAAAATTGACACTTACTTGCGGAGAGTTATCAGAAAATCAGCACAAGAAGA
GGAAAAGAATGCTCTCATCTAGCTCAGAGATGAATGAGGAATTCTTGAAAGAAAATAAT
TCTGTAGAATACAAGAAATCCAAGGCAGATTGTTCGAGGTGTGTAAGCTATAATCGAGA
GAAACAATTGAAGTTAAAAGAGTTAGAAGAGAATAAGAAATTGGAATGTGAATCTTCAT
GCATCATGAACGCCACTGGAAATCCTTACCTAGATGACATTGGTCTTCTCCAAGCTCTC
ACTGAGAAAATGGTTTTGGTATTTCTGTTACAACAAGGGTATAGTGACGGTTACACAAA
GTGGGATAAATTAAAACTATTTTTTGAATTATTTCCAGAGAAAATATGCCACGGCCTCC
CCAATTTGGGAAACACCTGTTATATGAATGCAGTGTTACAGTCTCTACTTTCAATCCCA
TCGTTTGCTGATGATTTACTTAATCAGAGTTTCCCATGGGGTAAAATTCCCCTTAATGC
TCTTACCATGTGCTTGGCACGGCTACTTTTTTTAAAGATACCTATAATATAGAAATCA
AGGAGATGTTACTCTTGAATCTTAAAAAGGCCATTTCAGCAGCTGCAGAGATATTCCAT
GGCAATGCACAGAACGATGCTCATGAGTTTTTAGCTCACTGTTTAGATCAACTGAAAGA
TAACATGGAAAAACTCAACACAATTTGGAAGCCTAAAAGTGAATTTGGGGAAGATAATT
TTCCTAAACAGGTTTTTGCTGATGATCCTGACACCAGTGGGTTTTCTTGCCCTGTCATT
ACTAATTTTGAGTTAGAGTTGTTGCACTCCATTGCTTGTAAAGCTTGTGGTCAGGTTAT
TCTCAAGACAGAACTGAATAATTACCTCTCCATCAACCTTCCCCAAAGAATAAAAGCAC
ATCCTTCATCTATTCAGTCTACTTTTGATCTTTTTTTTGGAGCAGAAGAGCTTGAGTAT
AAATGTGCAAAATGTGAGCACAAGACTTCCGTTGGAGTGCACTCATTCAGTAGGCTACC
TAGAATCCTTATTGTTCACCTCAAACGCTATAGCTTGAATGAGTTTTGTGCATTAAAGA
AGAATGACCAGGAAGTCATCATTTCCAAATATTTAAAGGTGTCTTCTCATTGCAATGAA
GGCACCAGACCACCTCTTCCCTTGAGTGAGGATGGAGAAATTACAGATTTCCAATTATT
AAAAGTTATTCGAAAGATGACTTCTGGAAACATCAGTGTATCATGGCCTGCAACAAAGG
AATCCAAAGATATCCTGGCTCCACACATTGGATCAGATAAGGAGTCTGAACAAAAAAAA
GGCCAGACAGTCTTTAAAGGGGCAAGCAGAAGACAGCAGCAAAAGTACCTTGGAAAAAA
TTCTAAACCAAATGAGCTAGAATCTGTATACTCAGGAGATCGAGCATTCATTGAAAAAG
AACCGTTAGCTCACTTAATGACGTATCTGGAAGATACCTCACTTTGTCAGTTCCACAAA
GCTGGAGGTAAACCTGCCAGCAGCCCAGGCACACCTCTCTCAAAAGTTGACTTTCAAAC
AGTGCCCGAAAATCCAAAACGAAAGAAATATGTGAAAACCAGTAAGTTTGTAGCTTTTG
ATAGGATTATCAATCCTACTAAAGATTTGTATGAAGATAAAAATATCAGAATTCCAGAA
AGATTCCAAAAAGTGTCTGAACAGACTCAGCAGTGTGACGGTATGAGAATCTGTGAACA
AGCCCCTCAGCAGGCACTGCCTCAAAGCTTTCCAAAGCCAGGCACCCAGGGGCACACAA
AGAACCTCCTAAGACCTACAAAATTAAATCTACAGAAGTCTAACAGGAATTCCCTACTT
GCACTGGGTTCCAATAAGAATCCAAGAAACAAAGACATTTTAGATAAGATAAAATCTAA
AGCCAAGGAAACAAAAAGAAATGATGATAAGGGAGATCATACCTACCGGCTCATTAGTG

Figure 64b

TTGTCAGCCATCTTGGGAAGACTCTAAAGTCAGGCCATTATATCTGTGATGCCTATGAC
TTTGAGAAACAGATCTGGTTCACTTACGATGATATGCGGGTGTTAGGTATCCAGGAGGC
CCAGATGCAGGAGGATAGGCGTTGCACTGGGTACATCTTCTTTTACATGCATAATGAGA
TCTTTGAAGAGATGTTGAAAAGAGAAGAGAATGCCCAGCTTAATAGCAAGGAGGTAGAG
GAGACCCTTCAGAAGGAATAA

Figure 65

SEQ ID NO.:65 hSPG25 encoded protein sequence

MAALFLRGFVQIGNCKTGISKSKEAFIEAVERKKKDRLVLYFKSGKYSTFRLSDNIQNV
VLKSYRGNQNHLHLTLQNNNGLFIEGLSSTDAEQLKIFLDRVHQNEVQPPVRPGKGGSV
FSSTTQKEINKTSFHKVDEKSSSKSFEIAKGSGTGVLQRMPLLTSKLTLTCGELSENQH
KKRKRMLSSSSEMNEEFLKENNSVEYKKSKADCSRCVSYNREKQLKLKELEENKKLECE
SSCIMNATGNPYLDDIGLLQALTEKMVLVFLLQQGYSDGYTKWDKLKLFFELFPEKICH
GLPNLGNTCYMNAVLQSLLSIPSFADDLLNQSFPWGKIPLNALTMCLARLLFFKDTYNI
EIKEMLLLNLKKAISAAAEIFHGNAQNDAHEFLAHCLDQLKDNMEKLNTIWKPKSEFGE
DNFPKQVFADDPDTSGFSCPVITNFELELLHSIACKACGQVILKTELNNYLSINLPQRI
KAHPSSIQSTFDLFFGAEELEYKCAKCEHKTSVGVHSFSRLPRILIVHLKRYSLNEFCA
LKKNDQEVIISKYLKVSSHCNEGTRPPLPLSEDGEITDFQLLKVIRKMTSGNISVSWPA
TKESKDILAPHIGSDKESEQKKGQTVFKGASRRQQQKYLGKNSKPNELESVYSGDRAFI
EKEPLAHLMTYLEDTSLCQFHKAGGKPASSPGTPLSKVDFQTVPENPKRKKYVKTSKFV
AFDRIINPTKDLYEDKNIRIPERFQKVSEQTQQCDGMRICEQAPQQALPQSFPKPGTQG
HTKNLLRPTKLNLQKSNRNSLLALGSNKNPRNKDILDKIKSKAKETKRNDDKGDHTYRL
ISVVSHLGKTLKSGHYICDAYDFEKQIWFTYDDMRVLGIQEAQMQEDRRCTGYIFFYMH
NEIFEEMLKREENAQLNSKEVEETLQKE

Figure 66

SEQ ID NO.:66 hSPG27 cDNA sequence

TACGAATTTAATACGACTCACTATAGGGAATTTGGCCCTCGAGGCCAAGAATTCGGCAC
GAGGGCCCGGCTGCCACCCTGTCTGAGAAGTGAGGAGCCTCTCCGCCCGGCAGCCACCC
CATCTGGTTGAATTAAAGAAAATACTTTATCAGAAGAAGATGGCCACTGCCCAGTTGCA
GAGGACTCCCATGAGTGCACTGGTATTTCCCAATAAGATATCAACTGAACACCAGTCTT
TGGTGTTAGTGAAGAGGCTTCTAGCAGTTTCAGTATCCTGTATCACGTATTTGAGGGGA
ATATTCCCAGAATGCGCTTATGGAACAAGATATCTAGATGGATGCTAGGATGTTATGAT
GCTTTACAGAAAAAATATCTAAGGATGGTTGTTCTAGCTGTATACACAAACCCAGAAGA
TCCTCAGACAATTTCACCATTCTGATGTTGGAGCGGCCGCAAGCTTATTCCCTTTAGTG
AGGGTTAATTTTAGCG

Figure 67a

SEQ ID NO.:67 hSPG34a cDNA sequence

AGCCGCCGCTGTCGTCCACCATGGTGGTGCTCCGAGGACCCCACCGCTGCCGCCACTGC
CCACGCCGATGCCGCTACCCGCTCCGGGCCCCTGGCAAACCCACTGCTTTTCCCCTCCT
CCCAGCGCCCGCGCTGCCCGCCCTGGGCCCGCTGTCGCAGGTGCAACGGTACCACCACC
CCAGCTGTGAGGCTGCCATCAACACCCACATCAGCCTGGAGCTCCACGCATCCTATGTG
TACCTGTCCATGGCCTTCTACTTCGACCAGGACGACGCGGCCCTGGAGCACTTTGACTG
CTACTTCCTGTGCCAGTTGCAGGAGAAAAGGGAGCACGCCCAGGAGCTGATGAGGCTGC
ACAACCTGCGCGGTGGCCGCATCTGCCTTCATGACGTCGGGAAGCCAGAGGGCCAAGGC
TGGGAGAGCGGGCTCAAGGCCATGGAGTGCGCCTTCCACCTGGAGAAGAACATCAACCA
GAGCCTCCTGGAGCTGCACCAGCTGGCCAAGGAGAACGGCGACCCCCAGCTTTGCGACT
TCCTGGAGAACCACTTCCTGAACCAGCAGGCCAAGACCATCAAAGAGCTGGGTGGCTAC
CTGAGCAACCTGCGCAAGATGGGGTCCCCGGAAGCAGGCCTGGCAGAGTACCTCTTTAA
CAAGCTCACCCTGGGCCGCAGCCAGAAACACACCTGAGCCCAGACAGGCCCCTCAGCCA

Figure 67b

TGGGGTGCCTTCCCCTGCTCGCGCCACCAGGCGGACGTCCATGTTGCCTTTTCAGAAC
ATTCTCTTCATTTTTCTCCTCTCAGTTTGACCATTGGTAACAATAAAGTTATCTGTTCT

SEQ ID NO.:68 hSPG34a encoded protein sequence Figure 68

MVVLRGPHRCRHCPRRCRYPLRAPGKPTAFPLLPAPALPALGPLSQVQRYHHPSCEAAI
NTHISLELHASYVYLSMAFYFDQDDAALEHFDCYFLCQLQEKREHAQELMRLHNLRGGR
ICLHDVGKPEGQGWESGLKAMECAFHLEKNINQSLLELHQLAKENGDPQLCDFLENHFL
NQQAKTIKELGGYLSNLRKMGSPEAGLAEYLFNKLTLGRSQKHT

SEQ ID NO.:69 hSPG34b cDNA sequence Figure 69

GGCCACCCGCCTTTCACTATCCGCCATTCTTGTCACCTCAGCTGCTGCCCTCGCTACCG
CACCGACTTCGCCCGTGTGCTCGCCTGCACTTGCGCTGCCCGCCATGGCCACCGCCCAG
CCGTCGCAGGTGCGCCAGAAGTACGACACCAACTGCGACGCCGCCATCAACAGCCACAT
CACGCTGGAGCTCTACACCTCCTACCTGTACCTGTCTATGGCCTTCTACTTCAACCGGG
ACGACGTGGCCCTGGAGAACTTCTTCCGCTACTTCCTGCGCCTGTCGGACGACAAAATG
GAGCATGCCCAGAAGCTGATGAGGCTGCAGAACCTGCGCGGTGGCCACATCTGCCTTCA
CGATATCAGGAAGCCAGAGTGCCAAGGCTGGGAGAGCGGGCTCGTGGCCATGGAGTCCG
CCTTCCACCTGGAGAAGAACGTCAACCAGAGCCTGCTGGATCTGTACCAGCTGGCCGTG
GAGAAGGGCGACCCCCAGCTGTGCCACTTCCTGGAGAGCCACTACCTGCACGAGCAAGT
CAAGACCATCAAAGAGCTGGGTGGCTACGTGAGCAACCTGCGCAAGATTTGTTCCCCGG
AAGCCGGCCTGGCTGAGTACCTGTTCGACAAGCTCACCCTGGGCGGCCGCGTCAAAGAG
ACTTGAGCCCAGATGGGCCCCACAGCCACGGGGTCCCTTCCCTGGGTCAGGCCACTAGG
CGGGGCGTGCATGTTGCCCTTTCAGAACGTTCTCTTCAGTTTTATCTTTCAGTTTTACC
ATTGTTAGCAAAAAAGTTATCTGGTTCTCAAAGCAATAAAGGTGTCCATAAAAAAAAAA
AAAAAAA

SEQ ID NO.:70 hSPG34b encoded protein sequence Figure 70

MATAQPSQVRQKYDTNCDAAINSHITLELYTSYLYLSMAFYFNRDDVALENFFRYFLRL
SDDKMEHAQKLMRLQNLRGGHICLHDIRKPECQGWESGLVAMESAFHLEKNVNQSLLDL
YQLAVEKGDPQLCHFLESHYLHEQVKTIKELGGYVSNLRKICSPEAGLAEYLFDKLTLG
GRVKET

SEQ ID NO.:71 hSPG39a cDNA sequence Figure 71a

GGGAGAGAGATCTTCCTCTCTCTTCGGGCGTGTTAAGACAGCGGGGTTGGCCTGTACTT
CCTCTGGCCCTGGCTGAAGAGGGCTAGTGAAACCGTTAAACCCCTAGGCGATCATGGCC
TTGAGACCTGAGGACCCCAGTAGCGGGTTCCGGCATAGCAACGTGGTGGCCTTCATCAA
CGAGAAAATGGCCAGGCACACGAAAGGCCCCGAGTTCTATCTTGAGAATATATCCTTAT
CCTGGGAGAAGGTGGAAGACAAGCTGAGGGCCATACTGGAGGACAGCGAGGTGCCCAGT
GAGGTCAAAGAGGCCTGCACCTGGGGCAGCCTGGCCTTGGGTGTGCGCTTTGCCCACAG
GCAGGCACAGCTACAAAGGCACAGGGTGCGGTGGCTGCACGGCTTCGCCAAACTGCACA
AATCAGCCGCACAGGCCTTGGCATCAGACCTGAAGAAGCTCAGGGAGCAGCAGGAGACG
GAACGCAAGGAGGCGGCCTCCCGGCTAAGAATGGCCCAGACCAGCCTCGTGGAGGTGCA
GAAAGAGAGAGACAAGGAGCTGGTGTCTCCCCATGAGTGGGAGCAGGGGGCAGGGTGGC
CAGGCCTGGCCACTGCCGGAGGGGTTTGCACAGAAGGAGCAGCTGAGGAGGAAGAAGAG
GCGGCGGTGGCTGCTGCTGGTGCTGCTGGAGGAAAAGGAGCAGAAGAAGAGCAGAGGGA
TGTGGAGGTTGTGGCTGCCCCTGTGGAGGCCATGGCTCCCCCTGTGGAGGCTGGGGCTG
CCCCCATGGAGACCCAGTTCCCCCACGTGGAGGCCAGGGCTGCCTCCATGGAGACCACA
GAGAAGCTGGAGAGAATCCTCCTGCAGCTCCTTGGAGATGCTGATCAGGAAAAGTACAC
CTATTGGGGGCAGAAGGAGGGAGATCTCCGGTCGGTCGAAACAGCCACATCTTATTTCT

Figure 71b

CTGGAACCACGAACCCCTGGTCCAGAGCCTCATCAGAACCTCTTCCTGTCCAGCTCCCT
GCCTCATACTCATACTCATACTCAAGCCCTTTTTCCTCCTTCTCAGACATACCCACTAT
ATCCCCTCCACAAGCAACAGTCACAGCACCAGTTCCGCCTCAGCTGCCTTCCGACTGGG
AGGCCTTTGATACTAGCCTGTGGTCTGATGGGGGCCCCACAGAATAGACCATCAGGAG
CACCCAAGAGACAGGAGATACTCCGAACCTCATCAGCAAAGACCTCCAGTATATCGCAG
GCCAGGGGACTGGGACTGCCCTTGGTGTAACGCTGTGAATTTTTCACGGAGGGATACTT
GCTTCGACTGTGGGAAGGGAATCTGGCTGCAAAAACCTCATTGAGTGCAGAAATGCAAA
ATAGAACCGAAGCATGTATAAAAAAA

Figure 72

SEQ ID NO.:72 hSPG39a encoded protein sequence

MALRPEDPSSGFRHSNVVAFINEKMARHTKGPEFYLENISLSWEKVEDKLRAILEDSEV
PSEVKEACTWGSLALGVRFAHRQAQLQRHRVRWLHGFAKLHKSAAQALASDLKKLREQQ
ETERKEAASRLRMAQTSLVEVQKERDKELVSPHEWEQGAGWPGLATAGGVCTEGAAEEE
EEAAVAAAGAAGGKGAEEEQRDVEVVAAPVEAMAPPVEAGAAPMETQFPHVEARAASME
TTEKLERILLQLLGDADQEKYTYWGQKEGDLRSVETATSYFSGTTNPWSRASSEPLPVQ
LPASYSYSYSSPFSSFSDIPTISPPQATVTAPVPPQLPSDWEAFDTSLWSDGGPHRIDH
QEHPRDRRYSEPHQQRPPVYRRPGDWDCPWCNAVNFSRRDTCFDCGKGIWLQKPH

Figure 73a

SEQ ID NO.:73 hSPG39a genomic DNA sequence

GGGAGAGAGATCTTCCTCTCTCTTCGGGCGTGTTAAGACAGCGGGGTTGGCCTGTACTT
CCTCTGGCCCTGGCTGAAGAGGTGAGGCCTGGTGGGAGGTGTCCTAGGGTAGGACAAGC
CGGTCAGGGGGTCATTAGGACGGTCTTGTCAGAGCGGGTAGGGCGGGGACAAGAGGGCG
GGAGAAGATGGATGAGGGGAGGGGCTAAGGGGGAGGAAAGGAACCTATTGGCTGCTCCA
TCCACACAGGGCTAGTGAAACCGTTAAACCCCTAGGCGATCATGGCCTTGAGACCTGAG
GACCCCAGTAGCGGGTTCCGGCATAGCAACGTGGTGGCCTTCATCAACGAGAAAATGGC
CAGGCACACGAAAGGCCCCGAGTTCTATCTTGAGAATATATCCTTATCCTGGGAGAAGG
TGGAAGACAAGCTGAGGGCCATACTGGAGGACAGCGAGGTGCCCAGTGAGGTCAAAGAG
GCCTGCACCTGGGGCAGCCTGGCCTTGGGAGTGCGCTTTGCCCACAGGCAGGCACAGCT
ACAAAGGCACAGGGTGCGGTGGCTGCACGGCTTCGCCAAACTGCACAAATCAGCCGCAC
AGGCCTTGGCATCAGACCTGAAGAAGCTCAGGGAGCAGCAGGAGACGGAACGCAAGGAG
GCGGCCTCCCGGCTAAGAATGGCCCAGACCAGCCTCGTGGAGGTGCAGAAAGAGAGAGA
CAAGGTGAGTTGGAAGCCGCTCCATGCAGTAAGATCCCTCAACTGGTCCCTGCCCAGTA
CCACTGCCCTGCCCCATTCCCACCCCTCTCCACCCTGCTCCATGGCTTCGCCCTGCCCC
GCCCTTCCCACCTGGTAGCTCCGTCCTACCCTGCTTAGTGCTCCCGCCTTGCCCCCAGA
ACACACCTCAGCCCTGCCCACTTCTCTCCAGGAGCTGGTGTCTCCCCATGAGTGGGAGC
AGGGGGCAGGGTGGCCAGGCCTGGCCACTGCCGGAGGGGTTTGCACAGAAGGAGCAGCT
GAGGAGGAAGAAGAGGCGGCGGTGGCTGCTGCTGGTGCTGCTGGAGGAAAAGGAGCAGA
AGAAGAGCAGAGGGGATGTTGGAGGTTGTGGCTGCCCCTGTGGAGGCCATGGCTCCCCC
TGTGGAGGCTGGGGCTGCCCCCATGGAGACCCAGTTCCCCCACGTGGAGGCCAGGGCTG
CCTCCATGGAGACCACAGAGAAGCTGGAGAGAATCCTCCTGCAGCTCCTTGGAGATGCT
GATCAGGAAAAGTACACCTATTGGGGGCAGAAGGAGGGAGATCTCCGGTCGGTCGAAAC
AGCCACATCTTATTTCTCTGGAACCACGAACCCCTGGTCCAGAGCCTCATCAGAACCTC
TTCCTGTCCAGCTCCCTGCCTCATACTCATACTCATACTCAAGCCCTTTTTCCTCCTTC
TCAGACATACCCACTATATCCCCTCCACAAGCAACAGTCACAGCACCAGTTCCGCCTCA
GCTGCCTTCCGACTGGGAGGCCTTTGATACTAGCCTGTGGTCTGATGGGGGCCCCACA
GAATAGACCATCAGGAGCACCCAAGAGACAGGAGATACTCCGAACCTCATCAGCAAAGA
CCTCCAGTATATCGCAGGCCAGGGGACTGGGACTGCCCTTGGTGTAACGCTGTGAATTT

Figure 73b

TTCACGGAGGGATACTTGCTTCGACTGTGGGAAGGGAATCTGGCTGCAAAAACCTCATT
GAGTGCAGAAATGCAAAATAGAACCGAAGCATGTATA

Figure 74

SEQ ID NO.:74 hSPG39b cDNA sequence

TCTCTTCAGGCGTGTTAAGCAGCGGGGTTGGCCTGTACTTCCTCTGGCCCTGGCTGAAG
AGGGCTAGTGAAACCGTTAAGCCCCTAGGCGATCATGGCCTTGAGACCTGAGGACCCCA
GTAGTGGGTTCCGGCACGGAAACGTGGTGGCCTTCATCATCGAGAAAATGGCCAGGCAC
ACGAAAGGCCCCGAGTTCTACTTCGAGAATATATCCTTATCCTGGGAGGAGGTGGAAGA
CAAGCTCAGGGCCATCCTGGAGGACAGCGAGGTGCCCAGCGAGGTCAAAGAGGCCTGCA
CCTGGGGCAGCCTGGCCTTGGGTGTGCGCTTTGCCCACAGGCAGGGGCAGTTACAAAAC
CGCAGGGTGCAGTGGCTGCAAGGCTTTGCCAAACTGCACAGATCAGCTGCGCTGGTCTT
GGCCTCAAACCTGACGGAACTCAAGGAACAGCAGGAGATGGAATGCAATGAGGCGACCT
TCCAGTTGCAGCTAACCGAGACCAGCCTTGCGGAGGTGCAGAGAGAGCGGGACATGCTG
AGATGGAAGCTCTTCCATGCCGAGCTGGCACCTCCCCAGGGACAGGGCCAGGCTACAGT
GTTTCCAGGCCTGGCCACTGCCGGAGGGGATTGGACAGAAGGAGCAGGTGAGCAGGAAA
AGGAGGCGGTGGCTGCTGCTGGTGCTGCTGGAGGAAAAGGAGAGGAGAGGTATGCAGAG
GCAGGGCCTGCCCCCGCAGAGGTCTTGCAGGGGCTGGGAGGAGGCTTCAGGCAGCCCCT
CGGAGCTATTGTAGCAGGCAAATTACACCTTTGCGGGGCAGAGGGAGAAAGATCTCAGG
TCAGTACAAACAGCCATGTCTGTCTTCTCTGGGCTTGGGTCCACAGTCTCACTGGAGCC
TCTTCCTGTCCAGCTCCCTACCTCATTCACATACTCATACCCATGCCCTTTGTCCGCCT
TCTCAGCCATACCCAATATACCCCCTTCACCAGCAAAGGTCACAGAACGGGTTCCAACT
CAGATGCCTTTCAACTGGGGGGCCTCTGATGCTAGCCTGTGGTCAGATGTGGAGGCCCA
GGGAATAGACCCTCAAGAGCCCCCAAGAGACAGGAGAGACTCCGAACTCCATCAGCAGA
GAAGACCTCCAGTATATCGCAGGCCAGGGAACTGGGACTGCCCGTGGTGTAAAGCTGTG
AATTTTTCATGGAGGGAAAATTGCTTCCTCTGGGGAGGCGAATACGGCTGCAAAAGCCT
CAGTAAAT

Figure 75a

SEQ ID NO.:75 hSPG46 cDNA sequence

CGGCGAAAGTCCAGTATGTGGGTCCAGGGTCACTCTTCTAGAGCTTCCGCAACGGAAAG
TGTGAGTTTTTCAGGAATTGTTCAGATGGATGAAGATACACATTACGATAAAGTGGAAG
ATGTGGTTGGAAGTCACATAGAAGATGCAGTAACATTTTGGGCCCAGAGTATCAATAGA
AATAAGGATATCATGAAGATTGGTTGCTCACTGTCTGAAGTTTGCCCCCAGGCCAGTTC
AGTTTTGGGGAATCTTGACCCAAACAAGATTTATGGTGGATTATTTTCTGAAGATCAGT
GTTGGTACAGATGCAAAGTACTGAAAATCATCAGCGTTGAAAAGTGTCTGGTGAGGTAC
ATTGACTATGGAAATACTGAAATTCTAAATCGATCTGATATAGTTGAAATTCCTTTGGA
GCTGCAGTTTTCTAGTGTTGCCAAAAAGTATAAACTTTGGGGACTACACATTCCTTCTG
ATCAAGAAGTTACCCAGTTTGATCAGGGCACAACCTTTTTGGGGAGCTTGATTTTTGAA
AAGGAAATAAAAATGAGAATTAAAGCAACCTCTGAAGATGGAACAGTTATTGCTCAGGC
TGAGTATGGCAGTGTGGATATAGGGGAAGAGGTGCTTAAGAAAGGATTTGCAGAGAAAT
GCAGACTTGCTTCCAGAACTGACATCTGTGAGGAAAAAAAATTGGATCCTGGTCAACTT
GTTCTCAGGAACCTCAAAAGCCCCATTCCTTTGTGGGGGCATAGATCAAACCAGTCAAC
CTTCAGCAGGCCCAAGGGGCACTTAAGTGAGAAAATGACTCTTGACTTGAAGGATGAAA
ATGATGCAGGCAATCTTATAACATTTCCAAAGGAAAGTTTGGCTGTTGGTGACTTTAAT
TTAGGGTCTAACGTCAGCCTGGAAAAAATTAAGCAGGACCAGAAACTGATTGAAGAAAA
TGAAAAACTTAAAACAGAGAAGGACGCTCTTCTTGAAAGTTATAAGGCGTTAGAATTGA
AAGTAGAGCAGATTGCCCAGGAGCTGCAGCAAGAGAAGGCAGCTGCTGTGGATTTGACT
AACCACTTAGAATACACTCTGAAGACCTATATAGATACCAGAATGAAAAATCTGGCAGC

Figure 75b

TAAGATGGAAATACTGAAAGAAATGAGGCATGTCGACATCAGTGTCCGTTTCGGAAAAG
ACCTTTCAGATGCTATACAAGTGTTGGATGAAGGGTGCTTTACTACTCCAGCTTCTTTG
AATGGATTAGAGATAATATGGGCAGAATACAGTCTGGCTCAGGAGAATATTAAAACTTG
TGAATATGTGAGTGAAGGGAATATTTTGATTGCCCAAAGAAATGAAATGCAGCAGAAGC
TGTACATGTCAGTAGAAGATTTTATTCTGGAAGTTGATGAGTCATCTCTTAATAAACGC
TTAAAAACATTGCAGGATTTGTCAGTCTCTTTAGAAGCAGTGTATGGACAAGCCAAAGA
AGGAGCAAATTCTGATGAAATACTTAAAAAATTTTATGACTGGAAGTGTGATAAAAGAG
AGGAGTTCACCAGTGTTAGAAGTGAAACAGACGCTTCTCTGCACCGTCTTGTAGCATGG
TTCCAAAGAACCTTAAAGGTTTTTGACCTATCTGTGGAAGGATCACTGATTTCAGAAGA
CGCAATGGATAATATTGATGAAATCCTAGAGAAGACTGAGTCAAGTGTCTGCAAAGAGC
TGGAGATAGCTCTGGTTGATCAAGGTGATGCAGACAAGGAGATAATTTCAAATACATAT
AGTCAAGTACTGCAAAAGATTCATTCAGAGGAAAGGCTCATTGCCACAGTACAAGCTAA
GTACAAGGACAGTATTGAGTTTAAAAAGCAGCTTATTGAATATTTAAAGAAGATTCCCA
GTGTGGATCACTTGCTATCCATTAAGAAGACATTGAAAAGCTTAAAAGCTCTACTCAGA
TGGAAATTGGTTGAAAAGAGTAATTTGGAAGAGTCAGATGATCCTGATGGCTCTCAAAT
TGAGAAAATAAAAGAAGAAATAACTCAGCTGCGCAATAATGTCTTTCAGGAAATTTATC
ATGAGAGAGAGGAATATGAGATGCTAACTAGTTTGGCACAGAAATGGTTCCCTGAGCTG
CCTCTGCTTCATCCTGAAATAGGATTACTCAAATACATGAACTCTGGTGGTCTCCTTAC
AATGAGCTTGGAACGAGATCTTCTTGATGCTGAGCCCATGAAGGAACTTAGCAGCAAGC
GTCCTTTGGTACGTTCTGAGGTTAATGGGCAGATAATTCTGTTAAAGGCTATTCTGTG
GATGTTGACACAGAAGCCAAGGTGATTGAGAGAGCAGCCACCTACCATAGAGCTTGGAG
AGAAGCTGAAGGAGACTCAGGGTTACTGCCATTGATATTCCTGTTTTTATGTAAGTCTG
ATCCTATGGCTTATCTGATGGTCCCATACTACCCTAGGGCAAACCTGAATGCTGTTCAA
GCCAACATGCCTTTAAATTCAGAAGAAACTTTAAAGGTCATGAAAGGTGTTGCCCAGGG
TCTGCATACATTGCATAAGGCTGACATAATTCATGGATCACTTCATCAGAACAATGTAT
TTGCTTTAAACCGTGAACAAGGAATTGTTGGAGATTTTGACTTCACCAAATCTGTGAGT
CAGCGAGCCTCGGTGAACATGATGGTTGGTGACTTGAGTTTGATGTCACCTGAGTTGAA
AATGGGAAAACCTGCTTCTCCAGGTTCAGACTTATATGCTTATGGCTGCCTCTTATTAT
GGCTTTCTGTTCAAAATCAGGAGTTTGAGATAAATAAAGATGGAATCCCCAAAGTGGAT
CAGTTTCATCTGGATGATAAAGTCAAATCCCTCCTCTGTAGCTTGATATGTTATAGAAG
TTCAATGACTGCTGAACAAGTTTTAAATGCTGAATGTTTCTTGATGCCAAAGGAGCAAT
CAGTTCCAAACCCAGAAAAAGATACTGAATACACCCTATATAAAAAGGAAGAAGAAATA
AAGACGGAGAACTTGGATAAATGTATGGAGAAGCCAAGAAATGGTGAAGCCAACTTTGA
TTGTTAAATTATTATTGTTGTTGTTGCAGAGGTTCTTTTTAAAAACTTTGTTTGGTTTG
GTTAATACACAGAAATATCTAGAAATGTTCTGGGACTAGTTGAGTTGTATCTTTAGTAT
TCAGGTTGTGAAAAATAAAGATGTTTGGCTATGCAAAAAAA

SEQ ID NO.:76 hSPG46 encoded protein sequence Figure 76a

MWVQGHSSRASATESVSFSGIVQMDEDTHYDKVEDVVGSHIEDAVTFWAQSINRNKDIM
KIGCSLSEVCPQASSVLGNLDPNKIYGGLFSEDQCWYRCKVLKIISVEKCLVRYIDYGN
TEILNRSDIVEIPLELQFSSVAKKYKLWGLHIPSDQEVTQFDQGTTFLGSLIFEKEIKM
RIKATSEDGTVIAQAEYGSVDIGEEVLKKGFAEKCRLASRTDICEEKKLDPGQLVLRNL
KSPIPLWGHRSNQSTFSRPKGHLSEKMTLDLKDENDAGNLITFPKESLAVGDFNLGSNV
SLEKIKQDQKLIEENEKLKTEKDALLESYKALELKVEQIAQELQQEKAAAVDLTNHLEY
TLKTYIDTRMKNLAAKMEILKEMRHVDISVRFGKDLSDAIQVLDEGCFTTPASLNGLEI
IWAEYSLAQENIKTCEYVSEGNILIAQRNEMQQKLYMSVEDFILEVDESSLNKRLKTLQ
DLSVSLEAVYGQAKEGANSDEILKKFYDWKCDKREEFTSVRSETDASLHRLVAWFQRTL
KVFDLSVEGSLISEDAMDNIDEILEKTESSVCKELEIALVDQGDADKEIISNTYSQVLQ

Figure 76b

KIHSEERLIATVQAKYKDSIEFKKQLIEYLKKIPSVDHLLSIKKTLKSLKALLRWKLVE
KSNLEESDDPDGSQIEKIKEEITQLRNNVFQEIYHEREEYEMLTSLAQKWFPELPLLHP
EIGLLKYMNSGGLLTMSLERDLLDAEPMKELSSKRPLVRSEVNGQIILLKGYSVDVDTE
AKVIERAATYHRAWREAEGDSGLLPLIFLFLCKSDPMAYLMVPYYPRANLNAVQANMPL
NSEETLKVMKGVAQGLHTLHKADIIHGSLHQNNVFALNREQGIVGDFDFTKSVSQRASV
NMMVGDLSLMSPELKMGKPASPGSDLYAYGCLLLWLSVQNQEFEINKDGIPKVDQFHLD
DKVKSLLCSLICYRSSMTAEQVLNAECFLMPKEQSVPNPEKDTEYTLYKKEEEIKTENL
DKCMEKPRNGEANFDC

SEQ ID NO.:77 hSPG64 cDNA sequence Figure 77

gagggcgccggtgctttgttctgtctgaggccaggaagtttgaccgcgctgccATGCCG
AACCGTAAGGCCAGCCGGAATGCTTACTATTTCTTCGTGCAGGAGAAGATCCCCGAACT
ACGGCGACGAGGCCTGCCTGTGGCTCGCGTTGCTGATGCCATCCCTTACTGCTCCTCAG
ACTGGGCGCTTCTGAGGGAGGAAGAAAAGGAGAAATACGCAGAAATGGCTCGAGAATGG
AGGGCCGCTCAGGGAAAGGACCCTGGGCCCTCAGAGAAGCAGAAACCTGTTTTCACACC
ACTGAGGAGGCCAGGCATGCTTGTACCAAAGCAGAATGTTTCACCTCCAGATATGTCAG
CTTTGTCTTTAAAAGGTGATCAAGCTCTCCTTGGAGGCATTTTTTATTTTTTGAACATT
TTTAGCCATGGCGAGCTACCTCCTCATTGTGAACAGCGCTTCCTCCCTTGTGAAATTGG
CTGTGTTAAGTATTCTCTCCAAGAAGGTATTATGGCAGATTTCCACAGTTTTATAAATC
CTGGTGAAATTCCACGAGGATTTCGATTTCATTGTCAGGCTGCAAGTGATTCTAGTCAC
AAGATTCCTATTTCAAATTTTGAACGTGGGCATAACCAAGCAACTGTGTTACAAAACCT
TTATAGATTTATTCATCCCAACCCAGGGAACTGGCCACCTATCTACTGCAAGTCTGATG
ATAGAACCAGAGTCAACTGGTGTTTGAAGCATATGGCAAAGGCATCAGAAATCAGGCAA
GATCTACAACTTCTCACTGTAGAGGACCTTGTAGTGGGGATCTACCAACAAAAATTTCT
CAAGGAGCCCTCTAAGACTTGGATTCGAAGCCTCCTAGATGTGGCCATGTGGGATTATT
CTAGCAACACAAGGTGCAAGTGGCATGAAGAAAATGATATTCTCTTCTGTGCTTTAGCT
GTTTGCAAGAAGATTGCGTACTGCATCAGTAATTCTCTGGCCACTCTCTTTGGAATCCA
GCTCACAGAGGCTCATGTACCACTACAAGATTATGAGGCCAGCAATAGTGTGACACCCA
AAATGGTTGTATTGGATGCAGGGCGTTACCAGAAGCTAAGGGTTGGGAGTTCAGGATTC
TCTCATTTCAACTCTTCTAATGAGGAACAAAGATCAAACACACCCATTGGTGACTACCC
ATCTAGGGCAAAAATTTCTGGCCAAAACAGCAGCGTTCGGGGAAGAGGAATTACCCGCT
TACTAGAGAGCATTTCCAATTCTTCCAGCAATATCCACAAATTCTCCAACTGTGACACT
TCACTCTCACCTTACATGTCCCAAAAAGATGGATACAAATCTTTCTCTTCCTTATCTTA
Atgatggtactcttttcaatttctgaaaacagtaacaggcccaacttccttcttactac
agtcatattaaacagatcacatcaatgacaaatgtcactactataaaaactacttaatt
tgtaaggaaattgtttcatagatttaaaaaattgtggttggagagcatcttggcattt
gtgctttttttcttgagggattgttctgcttcctggctgtatgatgggtatatcattaa
agtttggagtcctatatgaacaaaactgacattttagagttgtacttttgggaatgtt
atagattgatcattctttccccctgataataaaggtattgaatatctgttatgaaaggtt
aaaaa

SEQ ID NO.:78 hSPG64 encoded protein sequence Figure 78a

MPNRKASRNAYYFFVQEKIPELRRRGLPVARVADAIPYCSSDWALLREEEKEKYAEMAR
EWRAAQGKDPGPSEKQKPVFTPLRRPGMLVPKQNVSPPDMSALSLKGDQALLGGIFYFL
NIFSHGELPPHCEQRFLPCEIGCVKYSLQEGIMADFHSFINPGEIPRGFRFHCQAASDS
SHKIPISNFERGHNQATVLQNLYRFIHPNPGNWPPIYCKSDDRTRVNWCLKHMAKASEI
RQDLQLLTVEDLVVGIYQQKFLKEPSKTWIRSLLDVAMWDYSSNTRCKWHEENDILFCA
LAVCKKIAYCISNSLATLFGIQLTEAHVPLQDYEASNSVTPKMVVLDAGRYQKLRVGSS

Figure 78b

GFSHFNSSNEEQRSNTPIGDYPSRAKISGQNSSVRGRGITRLLESISNSSSNIHKFSNC
DTSLSPYMSQKDGYKSFSSLS.

Figure 79a

SEQ ID NO.:79 hSPG85 cDNA sequence

GCTTCCGAAACCTTACTATGATATTGTTAAGTCAGGCATCCACGTCAAGCAGAAAGACC
GAACTATGAACCTTCAAGATATCCGGTATATTCTGAAGAATGACTTAAAGGATTTTACT
GGAGCCCAGAGAACTCAACCAACCGAGAGCCCCAGAGTGCAGAGATACGGACTCCATCC
CGATGTCAATGTCTATCTAGGACTGACTTCAGAACACCCCAGAGAGACACCTGACATGG
AAATCATAGAACTAAAGGAAATGGGCAGTCAACCTCATTCACCAAGGGTTCACTCTTTA
TTCACTGAGGGACACTAGATCCTCAGGCCCCAGATCCATGTCTGATGGCCAGGGAGAC
TCAGAATCAAGATGCTCCTTGCCCTGCTCCATTTATGGCAGAAGAGGCCAGCAGCCCCA
GCACAGGTCAGCCAAGCCTCTGCAGTTTCGAAATCAACGAGATCTACTCAGGCTGCTTG
ATTTTGGAAGATGACATAGAAGAGCCTCCAGGAGCTGCTTCATCTTTGGAGGCAGACGG
ACCTAACCAGGTAGATGAACTGAAATCCATGGAAGAAGAGCTGGATAAGATGGAGAGAG
AGGCGTGTTGTTTTGGCAGTGAGGATGAGAGCTCTTCAAAAGCTGAGACAGAGTACTCT
TTTGATGACTGGGACTGGCAAAACGGTTCACTCAGTTCACTCAGCCTTCCTGAGTCAAC
CAGAGAAGCCAAGAGCAATTTGAACAACATGTCCACGACTGAGGAGTATCTCATCAGTA
AGTGTGTGCTGGATCTAAAGATTATGCAGACAATAATGCACGAGAATGATGATAGGCTG
AGGAATATCGAGCAGATATTAGATGAAGTCGAGATGAAACAGAAGGAACAGGAAGAGCG
CATGTCTTTATGGGCCACTTCAAGAGAGTTTACAAATGCCTACAAGTTACCTCTGGCCG
TGGGCCCTCCATCTTTAAACTATATTCCTCCTGTCCTACAGCTTTCAGGGGGTCAGAAG
CCAGACACCAGTGGCAACTACCCAACCCTACCAAGATTTCCAAGAATGCTGCCGACTCT
TTGTGACCCTGGAAAACAGAACACAGATGAACAATTTCAGTGCACTCAAGGAGCCAAGG
ACAGTTTGGAAACAAGCAGGATCCAAAATACCAGTAGCCAGGGAAGACCTAGAGAGTCC
ACTGCCCAAGCCAAAGCCACACAGTTTAATAGTGCACTCTTCACTCTGTCAAGCCACCG
GCAGGGACCTTCTGCATCACCCAGCTGTCACTGGGACTCTACCAGGATGAGTGTGGAAC
CTGTTTCTTCTGAAATCTATAATGCAGAGTCCAGAAATAAAGATGATGGAAAGGTACAC
TTAAAATGGAAAATGGAGGTGAAAGAAATGGCAAAGAAAGCAGCTACTGGACAGCTCAC
AGTACCTCCTTGGCATCCTCAGAGTAGTCTGACTTTAGAGAGCGAGGCTGAAAATGAGC
CCGACGCCCTGCTGCAGCCCCCCATTAGGAGCCCAGAAAACACGGATTGGCAGCGAGTT
ATTGAGTATCATAGGGAAAATGATGAGCCCAGAGGAAATGGCAAGTTTGACAAGACGGG
CAACAATGACTGTGACAGTGACCAGCATGGCAGACAGCCCAGGCTTGGAAGCTTCACCA
GTATCAGGCACCCATCTCCCAGACAAAAGGAGCAACCAGAGCATAGTGAAGCCTTCCAA
GCAAGTTCTGACACATTGGTGGCTGTAGAGAAATCTTACAGTACCTCGAGTCCCATAGA
AGAGGACTTTGAAGGAATACAAGGTGCATTTGCCCAACCTCAAGTCTCTGGTGAGGAAA
AGTTCCAAATGAGAAAAATTCTTGGAAAGAATGCTGAGATTTTGCCCAGGTCTCAATTT
CAACCTGTACGAAGTACTGAAGATGAACAAGAAGAGACATCAAAGGAGTCACCAAAGGA
ACTGAAAGAGAAAGACATATCATTGACGGATATTCAAGACCTGTCTAGTATCTCCTATG
AACCAGACAGCTCTTTTAAGGAAGCTTCATGCAAAACACCCAAAATAAACCATGCACCT
ACCAGTGTCAGCACTCCACTCAGCCCAGGGTCCGTTTCTTCAGCTGCCAGTCAGTATAA
AGACTGCCTTGAAAGTATCACATTTCAGGTTAAGACAGAGTTTGCCTCTTGCTGGAACA
GTCAAGAATTTATTCAAACTTTGTCTGATGACTTTATAAGTGTCCGAGAGAGAGCAAAG
AAACTGGATTCTCTCCTTACTTCCTCTGAAACTCCCCCTTCAAGACTGACTGGTCTTAA
AAGATTGTCTTCATTTATTGGGGCTGGATCCCCCAGCCTTGTTAAGGCATGTGACTCAT
CACCACCCCATGCCACCCAGAGAAGGAGCCTGCCTAAAGTAGAAGCCTTCTCTCAGCAT
CGCATTGATGAGCTGCCACCACCATCTCAGGAGCTACTTGATGACATTGAGCTCTTGAA
ACAGCAGCAGGGCTCATCCACGGTGTTGCATGAGAACACAGCAAGTGATGGAGGAGGCA
CTGCAAATGATCAAAGGCACTTAGAAGAACAAGAAACTGACAGTAAAAAAGAAGATAGT

Figure 79b

AGTATGCTTTTGTCCAAAGAAACTGAAGATCTTGGAGAGGACACAGAGAGAGCTCACTC
TACTCTGGATGAGGACCTGGAAAGATGGCTGCAGCCACCTGAGGAGAGCGTGGAGCTAC
AAGACCTTCCCAAGGGCTCTGAAAGGGAGACAAATATCAAAGATCAAAAAGTTGGTGAA
GAGAAAAGAAAAAGGGAAGATAGCATTACACCAGAGAGAAGGAAATCAGAGGGTGTTCT
AGGGACTTCTGAAGAAGATGAACTAAAATCCTGTTTTTGGAAGCGACTAGGTTGGTCCG
AATCATCCAGGATAATCGTGCTGGATCAGAGTGACTTGTCAGACTGATTGGAATTGGAT
CATAGACGGACTCCTGGCCTGAGTTTGAGTGTCCTGGTTGTAAGCTCCTTTCTTCTCTT
TCTGCTTCAGTTGCTGTCAGGGCAGCAGTTCCAGTTCTGTAAGTCTCACTTTGTTCAGC
TGCCACAATAGACATCATCGTTTGGCCCTCTCTGTTAGCAGCACATTCAACCATTTGTT
TTCAGTCAGATTTCTGAAAAGTGAGAGGTAGTTTTGATAGTAAAAATTTTTGGTTGTGC
CTAGAATGGCTTTGGTTTTGTTGATGTTAATTTTCAAAAACTTTAACTCTTGTTATATA
ATAAAATGTTTAATTTTAATAACAGAAAAA

Figure 80

SEQ ID NO.:80 hSPG85 encoded protein sequence

MNLQDIRYILKNDLKDFTGAQRTQPTESPRVQRYGLHPDVNVYLGLTSEHPRETPDMEI
IELKEMGSQPHSPRVHSLFTEGTLDPQAPDPCLMARETQNQDAPCPAPFMAEEASSPST
GQPSLCSFEINEIYSGCLILEDDIEEPPGAASSLEADGPNQVDELKSMEEELDKMEREA
CCFGSEDESSSKAETEYSFDDWDWQNGSLSSLSLPESTREAKSNLNNMSTTEEYLISKC
VLDLKIMQTIMHENDDRLRNIEQILDEVEMKQKEQEERMSLWATSREFTNAYKLPLAVG
PPSLNYIPPVLQLSGGQKPDTSGNYPTLPRFPRMLPTLCDPGKQNTDEQFQCTQGAKDS
LETSRIQNTSSQGRPRESTAQAKATQFNSALFTLSSHRQGPSASPSCHWDSTRMSVEPV
SSEIYNAESRNKDDGKVHLKWKMEVKEMAKKAATGQLTVPPWHPQSSLTLESEAENEPD
ALLQPPIRSPENTDWQRVIEYHRENDEPRGNGKFDKTGNNDCDSDQHGRQPRLGSFTSI
RHPSPRQKEQPEHSEAFQASSDTLVAVEKSYSTSSPIEEDFEGIQGAFAQPQVSGEEKF
QMRKILGKNAEILPRSQFQPVRSTEDEQEETSKESPKELKEKDISLTDIQDLSSISYEP
DSSFKEASCKTPKINHAPTSVSTPLSPGSVSSAASQYKDCLESITFQVKTEFASCWNSQ
EFIQTLSDDFISVRERAKKLDSLLTSSETPPSRLTGLKRLSSFIGAGSPSLVKACDSSP
PHATQRRSLPKVEAFSQHRIDELPPPSQELLDDIELLKQQQGSSTVLHENTASDGGGTA
NDQRHLEEQETDSKKEDSSMLLSKETEDLGEDTERAHSTLDEDLERWLQPPEESVELQD
LPKGSERETNIKDQKVGEEKRKREDSITPERRKSEGVLGTSEEDELKSCFWKRLGWSES
SRIIVLDQSDLSD.

Figure 81a

SEQ ID NO.:81 hSPG13 long transcript cDNA sequence

actgttagtccaagctgaattccgggcgATGGCGGCAGAGGCTTCGAAGACTGGGCCTT
CTAGGTCTTCCTACCAGCGAATGGGGAGGAAGAGTCAGCCCTGGGGTGCCGCTGAAATC
CAGTGCACCAGGTGTGGAAGGAGGGTATCCAGATCATCCGGTCACCATTGTGAACTTCA
ATGTGGACATGCTTTTTGTGAACTATGCTTGTTAATGACTGAAGAATGCACCACAATTA
TATGCCCTGATTGTGAGGTTGCTACAGCTGTAAATACTAGACAACGCTACTACCCAATG
GCTGGATATATTAAGGAAGACTCCATAATGGAAAAACTGCAGCCTAAGACGATAAAGAA
TTGTTCTCAGGACTTTAAGAAGACTGCTGATCAGCTAACTACTGGTTTAGAACGTTCAG
CCTCCACAGACAAGACTCTTTTGAACTCATCAGCTGTAATGTTGGACACTAATACTGCA
GAAGAAATTGATGAAGCATTGAATACAGCACACCATAGTTTCGAACAGTTAAGCATTGC
TGGAAAAGCACTTGAACACATGCAGAAGCAAACGATAGAGGAAAGAGAAAGAGTTATAG
AAGTTGTGGAGAAACAGTTTGACCAACTTTTGGCTTTTTTTGATTCCAGGAAAAAGAAC
CTGTGTGAAGAATTTGCAAGAACTACTGATGATTATCTATCAAATTTAATAAAGGCTAA
AAGCTACATTGAAGAGAAAAAAAATAATTTGAATGCAGCTATGAACATAGCAAGAGCAT
TACAATTATCGCCTTCTCTAAGAACATACTGTGACCTGAATCAGATTATCCGGACTTTG
CAGTTAACTTCAGATAGTGAATTAGCACAAGTTAGTTCTCCACAACTAAGGAACCCTCC

Figure 81b

CAGGTTGAGTGTGAATTGCAGTGAGATCATCTGTATGTTCAACAATATGGAAAGATTG
AATTTAGGGACTCAACAAAATGTTATCCCCAAGAAAATGAAATTAGACAGAATGTTCAA
AAGAAATATAATAACAAAAAGGAACTTTCTTGTTACGATACATACCCACCGCTAGAAAA
GAAAAAGGTTGACATGTCTGTCCTAACCAGTGAAGCACCACCACCATCTTTGCAACCTG
AGACAAATGATGTACATTTAGAAGCAAAAAACTTCCAGCCACAGAAAGACGTTGCAACA
GCATCCCCTAAAACCATTGCTGTGTTACCTCAGATGGGATCTAGCCCTGATGTGATAAT
TGAAGAAATTATTGAAGACAACGTGGAAAGTTCTGCAGAGCTAGTTTTTGTAAGCCATG
TAATAGATCCTTGCCATTTCTACATTCGGAAGTATTCACAAATAAAAGACGCCAAAGTA
CTGGAGAAGAAGGTGAATGAATTTTGCAATAGGAGTTCACACCTTGATCCTTCAGACAT
TTTGGAACTAGGTGCAAGAATATTTGTCAGCAGTATTAAAAATGGAATGTGGTGTCGAG
GAACTATCACAGAATTAATTCCAATAGAGGGTAGAAATACCAGAAAACCTTGTAGTCCA
ACCAGATTATTTGTCCATGAAGTTGCACTAATACAAATATTCATGGTAGATTTTGGAAA
TTCTGAAGTCCTGATTGTCACTGGAGTTGTTGATACCCATGTGAGACCAGAACACTCTG
CTAAGCAACATATTGCACTAAATGATTTATGTCTGGTTCTAAGGAAATCTGAACCATAT
ACTGAAGGGCTGCTAAAAGACATCCAGCCATTAGCACAACCATGCTCATTGAAAGACAT
TGTTCCACAGAATTCAAATGAAGGCTGGGAAGAGGAAGCTAAAGTGGAATTTTTGAAAA
TGGTAAATAACAAGGCTGTTTCAATGAAAGTTTTTAGAGAAGAAGATGGTGTGCTTATT
GTAGATCTGCAAAAACCACCACCGAATAAAATAAGCAGTGATATGCCTGTGTCTCTTAG
AGATGCGCTAGTTTTTATGGAACTAGCAAAAGATCTGATCTAAtaaacttggttgagac
actttctcatttttcaatgtttctgtattggaagaagaacttaaagcttcctaatcta
ttttgttggcgtcattcctctgctgaatttttaaatgttcactctggcttacctgttaa
tggaagaatttgcataatatctacttagaaagatagtgggccccggag

SEQ ID NO.:82 hSPG13 long transcript encoded protein sequence

Figure 82

MAAEASKTGPSRSSYQRMGRKSQPWGAAEIQCTRCGRRVSRSSGHHCELQCGHAFCELC
LLMTEECTTIICPDCEVATAVNTRQRYYPMAGYIKEDSIMEKLQPKTIKNCSQDFKKTA
DQLTTGLERSASTDKTLLNSSAVMLDTNTAEEIDEALNTAHHSFEQLSIAGKALEHMQK
QTIEERERVIEVVEKQFDQLLAFFDSRKKNLCEEFARTTDDYLSNLIKAKSYIEEKKNN
LNAAMNIARALQLSPSLRTYCDLNQIIRTLQLTSDSELAQVSSPQLRNPPRLSVNCSEI
ICMFNNMGKIEFRDSTKCYPQENEIRQNVQKKYNNKKELSCYDTYPPLEKKKVDMSVLT
SEAPPPSLQPETNDVHLEAKNFQPQKDVATASPKTIAVLPQMGSSPDVIIEEIIEDNVE
SSAELVFVSHVIDPCHFYIRKYSQIKDAKVLEKKVNEFCNRSSHLDPSDILELGARIFV
SSIKNGMWCRGTITELIPIEGRNTRKPCSPTRLFVHEVALIQIFMVDFGNSEVLIVTGV
VDTHVRPEHSAKQHIALNDLCLVLRKSEPYTEGLLKDIQPLAQPCSLKDIVPQNSNEGW
EEEAKVEFLKMVNNKAVSMKVFREEDGVLIVDLQKPPPNKISSDMPVSLRDALVFMELA
KDLI.

Figure 83a

SEQ ID NO.:83 hSPG13 short transcript cDNA sequence

actgttagtccaagctgaattcgggcgATGGCGGCAGAGGCTTCGAAGACTGGGCCTT
CTAGGTCTTCCTACCAGCGAATGGGGAGGAAGAGTCAGCCCTGGGGTGCCGCTGAAATC
CAGTGCACCAGGTGTGGAAGGAGGGTATCCAGATCATCCGGTCACCATTGTGAACTTCA
ATGTGGACATGCTTTTTGTGAACTATGCTTGTTAATGACTGAAGAATGCACCACAATTA
TATGCCCTGATTGTGAGGTTGCTACAGCTGTAAATACTAGACAACGCTACTACCCAATG
GCTGGATATATTAAGGAAGACTCCATAATGGAAAAACTGCAGCCTAAGACGATAAAGAA
TTGTTCTCAGGACTTTAAGAAGACTGCTGATCAGCTAACTACTGGTTTAGAACGTTCAG
CCTCCACAGACAAGACTCTTTTGAACTCATCAGCTGTAATGTTGGACACTAATACTGCA
GAAGAAATTGATGAAGCATTGAATACAGCACACCATAGTTTCGAACAGTTAAGCATTGC

Figure 83b

TGGAAAAGCACTTGAACACATGCAGAAGCAAACGATAGAGGAAAGAGAAAGAGTTATAG
AAGTTGTGGAGAAACAGTTTGACCAACTTTTGGCTTTTTTTGATTCCAGGAAAAAGAAC
CTGTGTGAAGAATTTGCAAGAACTACTGATGATTATCTATCAAATTTAATAAAGGCTAA
AAGCTACATTGAAGAGAAAAAAAATAATTTGAATGCAGCTATGAACATAGCAAGAGCAT
TACAATTATCGCCTTCTCTAAGAACATACTGTGACCTGAATCAGATTATCCGGACTTTG
CAGTTAACTTCAGATAGTGAATTAGCACAAGTTAGTTCTCCACAACTAAGGAACCCTCC
CAGGTTGAGTGTGAATTGCAGTGAGATCATCTGTATGTTCAACAATATGGAAAGATTG
AATTTAGGGACTCAACAAAATGTTATCCCCAAGAAAATGAAATTAGACAGAATGTTCAA
AAGAAATATAATAACAAAAAGGAACTTTCTTGTTACGATACATACCCACCGCTAGAAAA
GAAAAAGGTTGACATGTCTGTCCTAACCAGTGAAGCACCACCACCTCCTTTGCAACCTG
AGACAAATGATGTACATTTAGAAGCAAAAAACTTCCAGCCACAGAAAGACGTTGCAACA
GCATCCCCTAAAACCATTGCTGTGTTACCTCAGATGGGATCTAGCCCTGATGTGATAAT
TGAAGAAATTATTGAAGACAACGTGGAAACATGCGGCACAGATGATCTTGGGGAGACAC
CTAGATATCCAAAAAAGCCTCTTCAGAAAAACTCATCTGTTCCTTTTGGATCAAAAGCA
GATACTGTAACAACTGTCTGAgcttgatgtagtggagtttactgtatgtgtagttctgc
agagctagtttttgtaagccatgtaatagatccttgccatttctacattcggaagtatt
cacaaataaaagacgccaaagtactggagaagaaggtgaa

Figure 84

SEQ ID NO.:84 hSPG13 short transcript encoded protein sequence
MAAEASKTGPSRSSYQRMGRKSQPWGAAEIQCTRCGRRVSRSSGHHCELQCGHAFCELC
LLMTEECTTIICPDCEVATAVNTRQRYYPMAGYIKEDSIMEKLQPKTIKNCSQDFKKTA
DQLTTGLERSASTDKTLLNSSAVMLDTNTAEEIDEALNTAHHSFEQLSIAGKALEHMQK
QTIEERERVIEVVEKQFDQLLAFFDSRKKNLCEEFARTTDDYLSNLIKAKSYIEEKKNN
LNAAMNIARALQLSPSLRTYCDLNQIIRTLQLTSDSELAQVSSPQLRNPPRLSVNCSEI
ICMFNNMGKIEFRDSTKCYPQENEIRQNVQKKYNNKKELSCYDTYPPLEKKKVDMSVLT
SEAPPPPLQPETNDVHLEAKNFQPQKDVATASPKTIAVLPQMGSSPDVIIEEIIEDNVE
TCGTDDLGETPRYPKKPLQKNSSVPFGSKADTVTTV.

Figure 85

SEQ ID NO.:85 hSPG39b encoded protein sequence
MALRPEDPSSGFRHGNVVAFIIEKMARHTKGPEFYFENISLSWEEVEDKLRAILEDSEV
PSEVKEACTWGSLALGVRFAHRQGQLQNRRVQWLQGFAKLHRSAALVLASNLTELKEQQ
EMECNEATFQLQLTETSLAEVQRERDMLRWKLFHAELAPPQGQGQATVFPGLATAGGDW
TEGAGEQEKEAVAAAGAAGGKGEERYAEAGPAPAEVLQGLGGGFRQPLGAIVAGKLHLC
GAEGERSQVSTNSHVCLLWAWVHSLTGASSCPAPYLIHILIPMPFVRLLSHTQYTPFTS
KGHRTGSNSDAFQLGGL.

Figure 86a

SEQ ID NO.:86 hSPG39b genomic sequence
TCTCTTCAGGCGTGTTAAGCAGCGGGGTTGGCCTGTACTTCCTCTGGCCCTGGCTGAAG
AGGTGAGGCCTGGTGGGAGATGTCCTAGGGTAGGACAAGCCGGTCAGAGGGTCATTAGG
AGGGTCTTGTCAGAGGTGGGAGGGCGGAGAAGACAGATGAGGGGAGGGGCTAAGGAGGA
GGAAAGAAACCTATTGGCTGCTCCATCCACACAGGGCTAGTGAAACCGTTAAGCCCCTA
GGCGATCATGGCCTTGAGACCTGAGGACCCCAGTAGTGGGTTCCGGCACGGAAACGTGG
TGGCCTTCATCATCGAGAAAATGGCCAGGCACACGAAAGGCCCCGAGTTCTACTTCGAG
AATATATCCTTATCCTGGGAGGAGGTGGAAGACAAGCTCAGGGCCATCCTGGAGGACAG
CGAGGTGCCCAGCGAGGTCAAAGAGGCCTGCACCTGGGGCAGCCTGGCCTTGGGTGTGC
GCTTTGCCCACAGGCAGGGGCAGTTACAAAACCGCAGGGTGCAGTGGCTGCAAGGCTTT
GCCAAACTGCACAGATCAGCTGCGCTGGTCTTGGCCTCAAACCTGACGGAACTCAAGGA

Figure 86b

ACAGCAGGAGATGGAATGCAATGAGGCGACCTTCCAGTTGCAGCTAACCGAGACCAGCC
TTGCGGAGGTGCAGAGAGAGCGGGACATGCTGAGATGGAAGCTCTTCCATGCCGTAAGA
TCCCCCGAATGGTCCCTGTCCAATGCCTCTGCCCTGCCCCAACCTGTCCGGACCCCCTG
CCCTGTCCCCAGAATGTGTTTCAGCTCTGCCTACTTCTCTCCAGGAGCTGGCACCTCCC
CAGGGACAGGGCCAGGCTACAGTGTTTCCAGGCCTGGCCACTGCCGGAGGGGATTGGAC
AGAAGGAGCAGGTGAGCAGGAAAAGGAGGCGGTGGCTGCTGCTGGTGCTGCTGGAGGAA
AAGGAGAGGAGAGGTATGCAGAGGCAGGGCCTGCCCCCGCAGAGGTCTTGCAGGGGCTG
GGAGGAGGCTTCAGGCAGCCCCTCGGAGCTATTGTAGCAGGCAAATTACACCTTTGCGG
GGCAGAGGGAGAAAGATCTCAGGTCAGTACAAACAGCCATGTCTGTCTTCTCTGGGCTT
GGGTCCACAGTCTCACTGGAGCCTCTTCCTGTCCAGCTCCCTACCTCATTCACATACTC
ATACCCATGCCCTTTGTCCGCCTTCTCAGCCATACCCAATATACCCCCTTCACCAGCAA
AGGTCACAGAACGGGTTCCAACTCAGATGCCTTTCAACTGGGGGGCCTCTGATGCTAGC
CTGTGGTCAGATGTGGAGGCCCAGGGAATAGACCCTCAAGAGCCCCCAAGAGACAGGAG
AGACTCCGAACTCCATCAGCAGAGAAGACCTCCAGTATATCGCAGGCCAGGGAACTGGG
ACTGCCCGTGGTGTAAAGCTGTGAATTTTTCATGGAGGGAAAATTGCTTCCTCTGTGGG
AGGCGAATCTGGCTGCAAAAGCCTCAGTAAAT

Figure 87a

SEQ ID NO.:87 hSPG70 cDNA sequence

GACTATATTCCTGTTAAGGGGGAAGTTTGTATTGCCAAGTACACTGTTGATCAGACCTG
GAACAGAGCAATCATACAAAACGTTGATGTGCAGCAAAAGAAGGCACATGTCTTATATA
TTGATTATGGAAATGAAGAAATAATTCCATTAAACAGAATTTACCACCTCAACAGGAAC
ATTGACTTGTTTCCTCCTTGTGCCATAAAGTGCTTTGTAGCCAATGTTATCCCAGCAGA
AGGGAATTGGAGCAGTGATTGTATCAAAGCTACTAAACCACTGTTAATGGAGCAGTACT
GCTCCATAAAGATTGTCGACATCTTGGAAGAGGAAGTGGTTACCTTTGCTGTAGAAGTT
GAGCTGCCAAATTCAGGAAAACTTTTAGACCATGTGCTTATAGAAATGGGATATGGCTT
GAAACCCAGTGGACAAGATTCTAAGAAGGAAAATGCAGATCAAAGTGATCCTGAAGATG
TTGGAAAAATGACAACTGAAAACAACATTGTCGTAGACAAAAGTGACCTAATCCCAAAA
GTGTTAACTTTGAATGTAGGTGATGAGTTTTGTGGTGTGGTTGCCCACATTCAAACACC
AGAAGACTTCTTTTGTCAACAACTGCAAAGTGGCCGAAAGCTTGCTGAACTTCAGGCAT
CCCTTAGCAAGTACTGTGATCAGTTGCCTCCACGCTCTGATTTTTATCCAGCCATTGGT
GATATATGTTGTGCTCAGTTCTCAGAGGATGATCAGTGGTACCGTGCCTCTGTTTTGGC
TTACGCTTCTGAAGAATCTGTACTGGTCGGATATGTAGATTATGGAAACTTTGAAATCC
TTAGTTTGATGAGACTTTGTCCCATAATCCCAAAGTTGTTGGAATTGCCAATGCAAGCT
ATAAAGTGTGTACTAGCAGGAGTAAAGCCATCATTAGGAATTTGGACTCCAGAAGCTAT
TTGTCTCATGAAAAAACTTGTACAGAACAAAATAATCACAGTGAAAGTGGTGGACAAGT
TGGAAAACAGTTCCCTGGTGGAGCTTATTGATAAATCCGAGACGCCTCATGTCAGTGTT
AGCAAAGTTCTCCTAGATGCAGGCTTTGCTGTGGGAGAACAGAGTATGGTGACAGATAA
ACCCAGTGACGTGAAAGAAACCAGTGTTCCCTTGGGTGTGGAAGGAAAAGTAAATCCAT
TGGAGTGGACATGGGTTGAACTTGGTGTTGACCAAACAGTAGATGTTGTGGTCTGTGTG
ATATATAGTCCTGGAGAATTTTATTGCCATGTGCTTAAAGAGGATGCTTTAAAGAAACT
CAATGATTTGAACAAGTCATTAGCAGAACACTGCCAGCAGAAGTTACCTAATGGTTTCA
AGGCAGAGATAGGACAACCTTGTTGTGCTTTTTTTGCAGGTGATGGTAGTTGGTATCGT
GCTTTAGTCAAGGAAATCTTACCAAATGGACATGTTAAAGTACATTTTGTGGATTATGG
AAACATCGAAGAAGTTACTGCAGATGAACTCCGAATGATATCATCAACATTTTTAAACC
TTCCCTTTCAGGGAATACGGTGCCAGTTAGCAGATATACAGTCTAGAAACAAACATTGG
TCTGAAGAAGCCATAACAAGATTCCAGATGTGTGTTGCTGGGATAAAATTGCAAGCCAG
AGTGGTTGAAGTCACTGAAAATGGGATAGGAGTTGAACTCACCGATCTCTCCACTTGTT
ATCCCAGAATAATTAGTGATGTTCTGATTGATGAACATCTGGTTTTAAAATCTGCTTCA

Figure 87b

CCACATAAAGACTTACCAAATGACAGACTTGTTAATAAACATGAGCTTCAAGTTCATGT
ACAGGGACTTCAAGCTACCTCTTCAGCTGAGCAATGGAAGACGATAGAATTGCCAGTGG
ATAAAACTATACAAGCAAATGTATTAGAAATCATAAGCCCAAACTTGTTTTATGCTCTA
CCAAAAGGGATGCCAGAAAATCAGGAAAAGCTGTGCATGTTGACAGCTGAATTATTAGA
ATACTGCAATGCTCCGAAAAGTCGACCACCCTATAGACCAAGAATTGGAGACGCATGCT
GTGCCAAATACACAAGTGATGATTTTTGGTATCGTGCAGTTGTTCTGGGGACATCAGAC
ACTGATGTGGAAGTGCTCTATGCAGACTATGGAAACATTGAAACCCTGCCTCTTTGCAG
AGTGCAACCAATCACCTCTAGCCACCTGGCGCTTCCTTTCCAAATTATTAGATGTTCAC
TTGAAGGATTAATGGAATTGAATGGAAGCTCTTCTCAATTAATAATAATGCTATTAAAA
AATTTCATGTTGAATCAGAATGTAATGCTTTCTGTGAAAGGAATTACAAAGAATGTCCA
TACAGTGTCAGTTGAGAAATGTTCTGAGAATGGGACTGTCGATGTAGCTGATAAGCTAG
TGACATTTGGTCTGGCAAAAAACATCACACCTCAAAGGCAGAGTGCTTTAAATACAGAA
AAGATGTATAGGACGAATTGCTGCTGCACAGAGTTACAGAAACAAGTTGAAAAACATGA
ACATATTCTTCTCTTCCTCTTAAACAATTCAACCAATCAAAATAAATTTATTGAAATGA
AAAAACTGGTAAAAAGTTAAGTAAGTTAAATCGTATGTTTTCGCCTCTTCTGTGATCAC
CAATAGGACATCTTCAGGCATATTGGCAGGATAGAGCTAATGGAGTGAAACCTATTGTA
AGGCTGTACTTTCGTGATTTAATGACCTGAGGTTTGGTCATAATGCTTCTGCTGTTTTT
GTAGGTTTATCTGATCGTTTTCCTTTGCTACTGCTAATGGAACTGAACCCCCAGGGGTA
TTCCAGTTGTAATAGCCTTTCCTTACTGTTGTTTGGTTCTGTGAATGCCTATGTTATTG
ATATGTGGAGGGCCGGAATTCTTTTGCTA

Figure 88

SEQ ID NO.:88 hSPG70 encoded protein sequence
MEQYCSIKIVDILEEEVVTFAVEVELPNSGKLLDHVLIEMGYGLKPSGQDSKKENADQS
DPEDVGKMTTENNIVVDKSDLIPKVLTLNVGDEFCGVVAHIQTPEDFFCQQLQSGRKLA
ELQASLSKYCDQLPPRSDFYPAIGDICCAQFSEDDQWYRASVLAYASEESVLVGYVDYG
NFEILSLMRLCPIIPKLLELPMQAIKCVLAGVKPSLGIWTPEAICLMKKLVQNKIITVK
VVDKLENSSLVELIDKSETPHVSVSKVLLDAGFAVGEQSMVTDKPSDVKETSVPLGVEG
KVNPLEWTWVELGVDQTVDVVVCVIYSPGEFYCHVLKEDALKKLNDLNKSLAEHCQQKL
PNGFKAEIGQPCCAFFAGDGSWYRALVKEILPNGHVKVHFVDYGNIEEVTADELRMISS
TFLNLPFQGIRCQLADIQSRNKHWSEEAITRFQMCVAGIKLQARVVEVTENGIGVELTD
LSTCYPRIISDVLIDEHLVLKSASPHKDLPNDRLVNKHELQVHVQGLQATSSAEQWKTI
ELPVDKTIQANVLEIISPNLFYALPKGMPENQEKLCMLTAELLEYCNAPKSRPPYRPRI
GDACCAKYTSDDFWYRAVVLGTSDTDVEVLYADYGNIETLPLCRVQPITSSHLALPFQI
IRCSLEGLMELNGSSSQLIIMLLKNFMLNQNVMLSVKGITKNVHTVSVEKCSENGTVDV
ADKLVTFGLAKNITPQRQSALNTEKMYRTNCCCTELQKQVEKHEHILLFLLNNSTNQNK
FIEMKKLVKS

Figure 89a

Human TEX11 cDNA sequence:

TGGTTAAGTCCAAGCTGACAATGATGATTTTTTTTCCATGGACTTTAAAGAAG
TTGTTGAAAACCTGGTTACAAATGATAATTCACCTAACATACCAGAGGCAATT
GATAGACTCTTCAGCGACATAGCAAATATCAACAGGGAGTCTATGGCTGAAA
TAACAGACATTCAGATTGAAGAAATGGCAGTAAACCTATGGAACTGGGCACT
TACCATAGGAGGAGGTTGGCTTGTAAATGAAGAGCAGAAAATTAGATTACAT
TATGTTGCTTGCAAGTTGCTGAGTATGTGTGAAGCCTCATTTGCCTCAGAAC
AAAGTATTCAACGACTGATTATGATGAATATGAGAATAGGAAAAGAATGGTT
GGATGCTGGAAATTTTCTAATCGCTGATGAATGTTTTCAAGCTGCTGTGGCC
AGTCTGGAGCAATTATACGTCAAATTAATTCAAAGGAGCTCCCCTGAGGCTG
ACTTGACCATGGAGAAGATTACTGTTGAGAGTGACCACTTCAGAGTGCTTTC
TTACCAAGCAGAGTCAGCAGTTGCTCAAGGGGATTTTCAAAGAGCATCTATG
TGTGTACTGCAATGTAAAGATATGTTGATGAGGCTCCCCCAGATGACTTCAA
GTCTTCATCATCTCTGTTACAACTTTGGAGTAGAAACCCAGAAGAATAATAAA
TATGAAGAAAGTTCTTTCTGGCTTAGCCAAAGCTATGATATTGGGAAGATGG
ATAAGAAATCTACTGGGCCAGAAATGCTGGCTAAAGTTCTACGGCTATTAGC
CACGAATTATTTGGATTGGGATGACACCAAATATTATGATAAGGCTCTCAAT
GCTGTAAACCTAGCAAACAAGGAACATTTAAGTTCTCCTGGGCTTTTCTTAA
AAATGAAAATCCTCTTGAAAGGCGAAACATCTAATGAAGAACTCCTTGAAGC
TGTCATGGAAATACTACATCTTGACATGCCCTTAGACTTCTGTCTGAACATT
GCTAAACTGCTGATGGATCATGAAAGAGAATCTGTTGGGTTTCATTTCCTGA
CGATTATTCATGAACGTTTTAAGTCATCGGAAAATATTGGAAAAGTTCTGATA
CTCCATACTGACATGCTTTTACAAAGGAAGGAAGAACTTCTTGCCAAGGAGA
AGATTGAAGAAATCTTTTTAGCTCACCAAACAGGAAGACAACTGACAGCAGA
ATCAATGAACTGGTTACACAACATTCTGTGGAGACAAGCTGCCAGTAGTTTT
GAGGTACAAAATTACACTGATGCCCTACAATGGTACTATTATTCTCTGAGGT
TTTATTCAACTGATGAAATGGATCTGGACTTCACCAAGCTGCAGAGGAACAT
GGCTTGCTGTTACCTGAATTTGCAACAACTTGATAAGGCCAAAGAGGCAGT
GGCAGAAGCTGAACGACATGACCCTAGGAACGTTTTCACTCAATTTTATATA
TTCAAGATTGCAGTCATAGAGGGCAACTCTGAAAGAGCTTTGCAGGCAATAA
TTACTTTAGAGAATATATTAACAGATGAAGAGTCAGAAGATAATGATCTAGTT
GCAGAGAGAGGTTCACCTACCATGCTTCTAAGTTTAGCTGCCCAGTTTGCTC
TAGAGAATGGACAACAAATTGTGGCAGAAAAAGCTTTGGAATATTTAGCTCA
ACATTCAGAAGACCAGGAACAAGTTCTTACAGCTGTAAAGTGTTTGCTTCGT
TTTCTTCTTCCAAAAATTGCTGAAATGCCGGAATCTGAAGATAAGAAGAAAG
AAATGGATCGACTTTTGACTTGCCTGAATAGAGCCTTTGTGAAACTTTCTCA
GCCTTTTGGTGAAGAAGCCTTAAGTTTGGAGTCAAGAGCTAATGAAGCTCA
GTGGTTTCGAAAAACAGCTTGGAACTTGGCTGTGCAATGTGACAAAGATCC
AGTGATGATGAGAGAGTTTTTTATACTTTCTTATAAGATGTCCCAGTTTTGTC
CTTCTGATCAAGTAATTCTGATTGCACGGAAAACATGTTTACTTATGGCAGTT
GCAGTTGATCTAGAGCAAGGGAGAAAAGCTTCAACAGCTTTTGAACAGACC
ATGTTCCTGAGTCGTGCACTTGAGGAGATCCAGACATGCAATGACATCCATA
ATTTCCTGAAACAAACAGGGACCTTCTCAAATGATTCATGTGAGAAATTGCT
TCTGCTGTACGAGTTTGAAGTTAGAGCCAAATTGAATGATCCATTACTGGAA
AGCTTCCTGGAATCAGTGTGGGAGTTGCCTCATTTAGAAACTAAAACATTTG

AAACAATTGCAATAATAGCAATGGAAAAGCCTGCACACTATCCTTTGATTGC
TCTCAAGGCCTTGAAAAAGGCTTTATTGCTCTACAAAAAGGAAGAACCAATT
GATATATCACAATACAGCAAATGTATGCACAACTTGGTTAACCTCTCAGTGC
CAGATGGGGCGTCGAATGTAGAGCTCTGTCCCCTGGAAGAAGTTTGGGGC
TATTTTGAAGATGCTCTGAGCCACATTAGCCGCACTAAAGACTACCCAGAAA
TGGAGATTCTCTGGCTGATGGTCAAGTCCTGGAATACCGGAGTACTTATGTT
TAGCAGGAGCAAGTATGCATCTGCTGAAAAGTGGTGTGGCCTGGCCTTGCG
TTTCCTTAACCACCTTACCTCCTTCAAGGAAAGCTATGAAACTCAGATGAATA
TGCTGTATAGTCAGCTTGTGGAAGCATTGAGTAACAACAAGGGCCCAGTTTT
TCATGAACATGGCTACTGGAGCAAGTCAGATTAGGCAAGCTCATGGCCACA
TGAAGAAGATACATTGTCCCGAGATGCTGACTGTTTAAATTTTTGCCAGAGT
TTCTCTTGAGCTTTTGTTTCTGTTTGCTCAGACCCTGTTTTCATGTTGTTGAA
TAAACTTTCTAAAATAAAAGCATGCTGAATTT

Figure 89b

Human TEX11 protein sequence:
MDFKEVVENLVTNDNSPNIPEAIDRLFSDIANINRESMAEITDIQIEEMAVNLWN
WALTIGGGWLVNEEQKIRLHYVACKLLSMCEASFASEQSIQRLIMMNMRIGKE
WLDAGNFLIADECFQAAVASLEQLYVKLIQRSSPEADLTMEKITVESDHFRVLSY
QAESAVAQGDFQRASMCVLQCKDMLMRLPQMTSSLHHLCYNFGVETQKNNK
YEESSFWLSQSYDIGKMDKKSTGPEMLAKVLRLLATNYLDWDDTKYYDKALNA
VNLANKEHLSSPGLFLKMKILLKGETSNEELLEAVMEILHLDMPLDFCLNIAKLLM
DHERESVGFHFLTIIHERFKSSENIGKVLILHTDMLLQRKEELLAKEKIEEIFLAHQ
TGRQLTAESMNWLHNILWRQAASSFEVQNYTDALQWYYYSLRFYSTDEMDLD
FTKLQRNMACCYLNLQQLDKAKEAVAEAERHDPRNVFTQFYIFKIAVIEGNSER
ALQAIITLENILTDEESEDNDLVAERGSPTMLLSLAAQFALENGQQIVAEKALEYL
AQHSEDQEQVLTAVKCLLRFLLPKIAEMPESEDKKKEMDRLLTCLNRAFVKLSQ
PFGEEALSLESRANEAQWFRKTAWNLAVQCDKDPVMMREFFILSYKMSQFCP
SDQVILIARKTCLLMAVAVDLEQGRKASTAFEQTMFLSRALEEIQTCNDIHNFLK
QTGTFSNDSCEKLLLLYEFEVRAKLNDPLLESFLESVWELPHLETKTFETIAIIAM
EKPAHYPLIALKALKKALLLYKKEEPIDISQYSKCMHNLVNLSVPDGASNVELCPL
EEVWGYFEDALSHISRTKDYPEMEILWLMVKSWNTGVLMFSRSKYASAEKWC
GLALRFLNHLTSFKESYETQMNMLYSQLVEALSNNKGPVFHEHGYWSKSD

Figure 90

Identification of spermatogonia-specific genes by cDNA subtraction

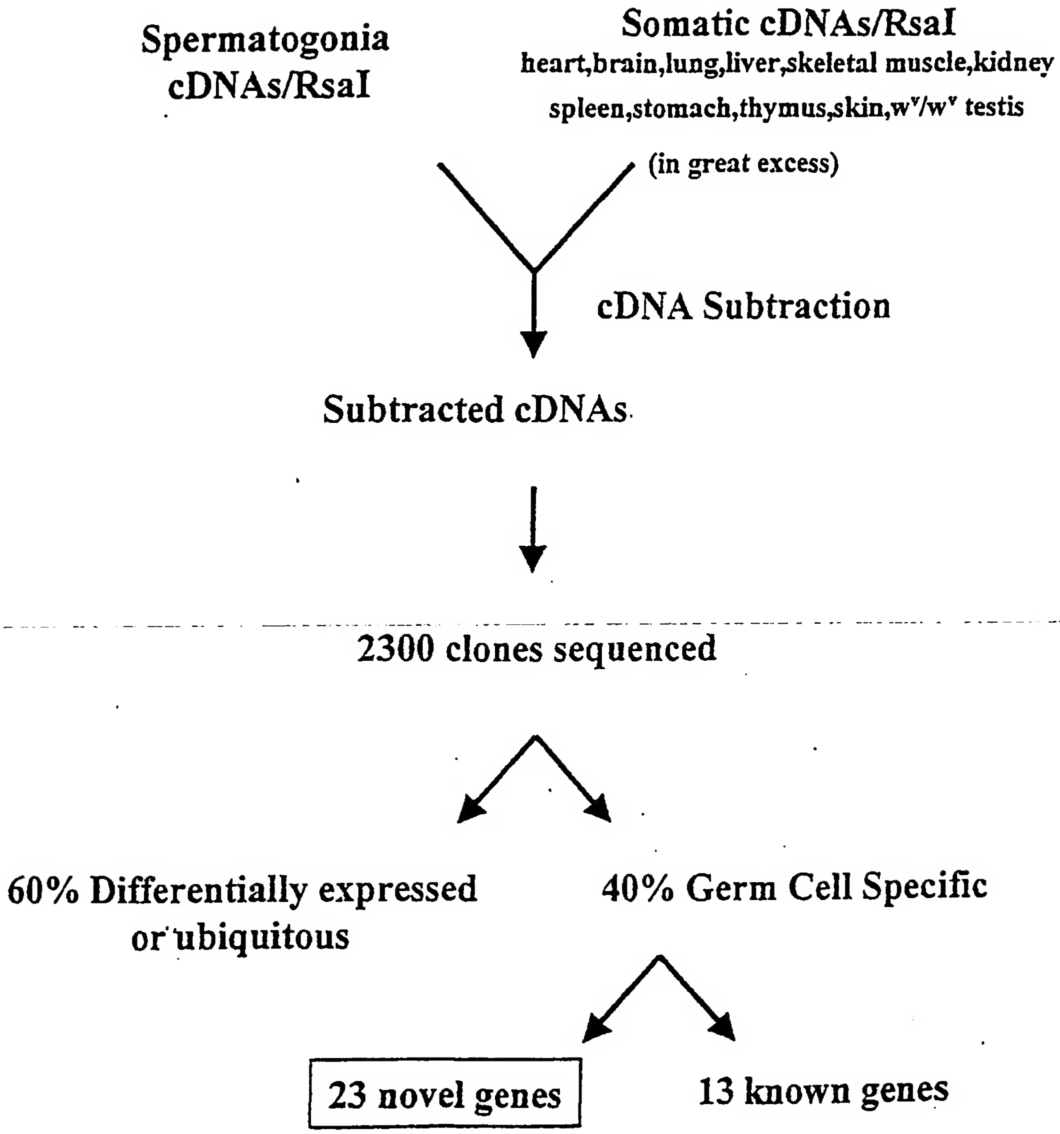


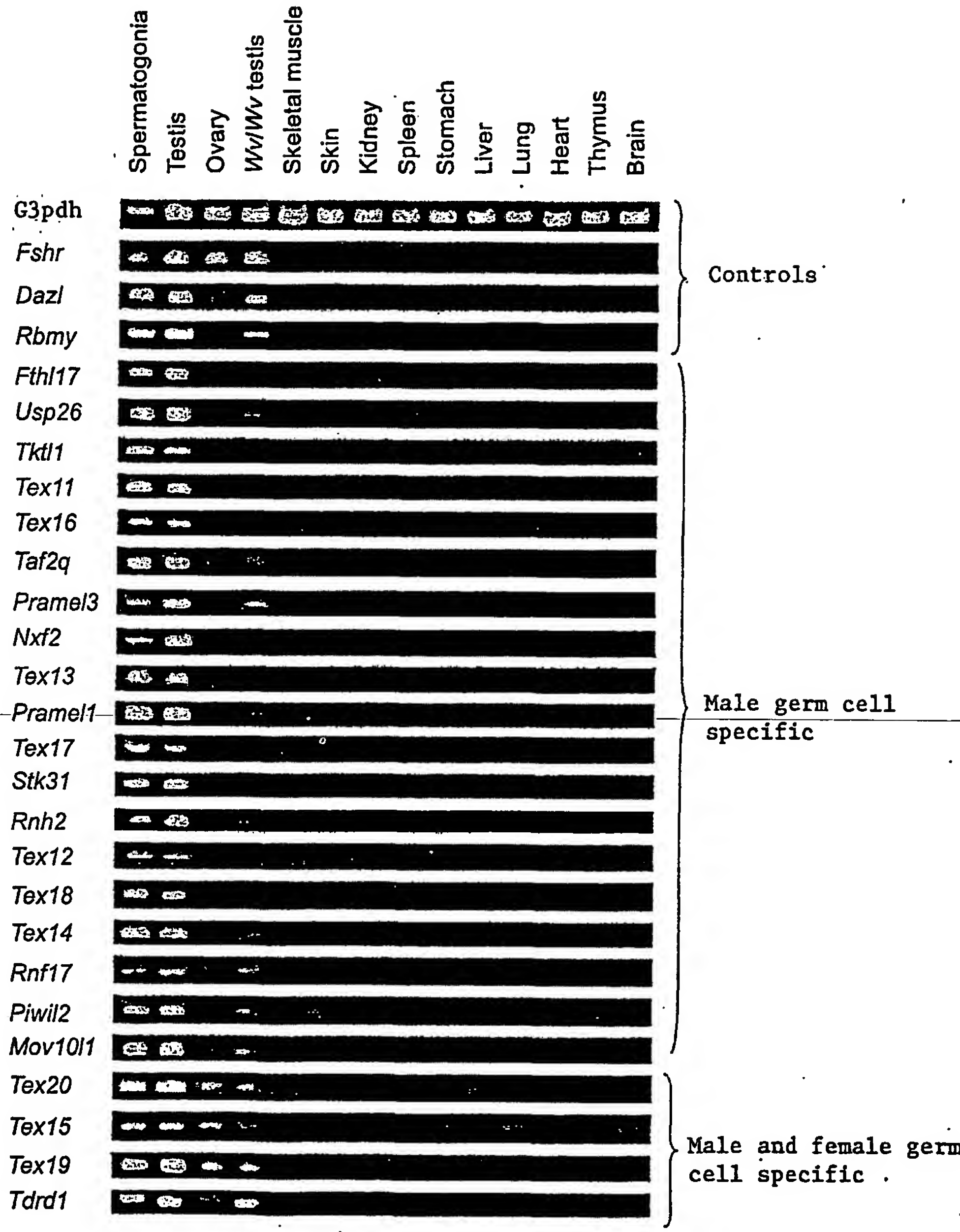
Figure 91

Known germ cell-specific genes enriched by subtraction

Gene	Chr	Source	Significance
Rbmy	Y	Elliott,1996	implicated in male fertility
Dazl	17	Reijo,1996	implicated in male fertility
Ube1y	Y	Mitchell,1991	spermatogonial proliferation
Usp9y	Y	Ehrmann,1998	implicated in male fertility
Sycp 1	3	Sage, 1997	meiosis
Sycp 2	2	Wang, unpublished	meiosis
Sycp 3	10	Klink, 1997	meiosis
Figla	6	Liang, 1997	bHLH transcription factor
Ddx4	13	Fujiwara, 1994	germ cell determination in fly
Tuba3/Tuba7	6	Villasante, 1986	testis specific tubulin isoform
Ott	X	Kerr, 1996	meiosis
Mage	X	De Plaen, 1999	melanoma associated antigen
Stra8	6	Oulad-Abdelghani, 1996	Induced by retinoic acid

The subtraction is highly sensitive and comprehensive

Figure 92



23 novel mouse germ cell specific genes

Figure 93

Novel mouse germ cell specific genes

Gene	Significance
Taf2q	Transcription initiation factor
Nxf2	Nuclear mRNA export factor
Rnf17	RING finger protein interacting with all mad members of the Myc oncoprotein pathway
Mov10l1	Putative RNA helicase
Piwil2	Homologue of piwi involved in germ cell renewal in fly
Tktl1	Transketolase
Usp26	Ubiquitin specific protease
Fthl17	Ferritin heavy chain; iron metabolism
Stk31	Putative protein kinase with One tudor domain
Rnh2	Ribonuclease inhibitor
Tdrd1	Four tudor domains
TEX14	putative protein kinase
Pramel1	Prame-like gene
10 genes	No homology with proteins in the database

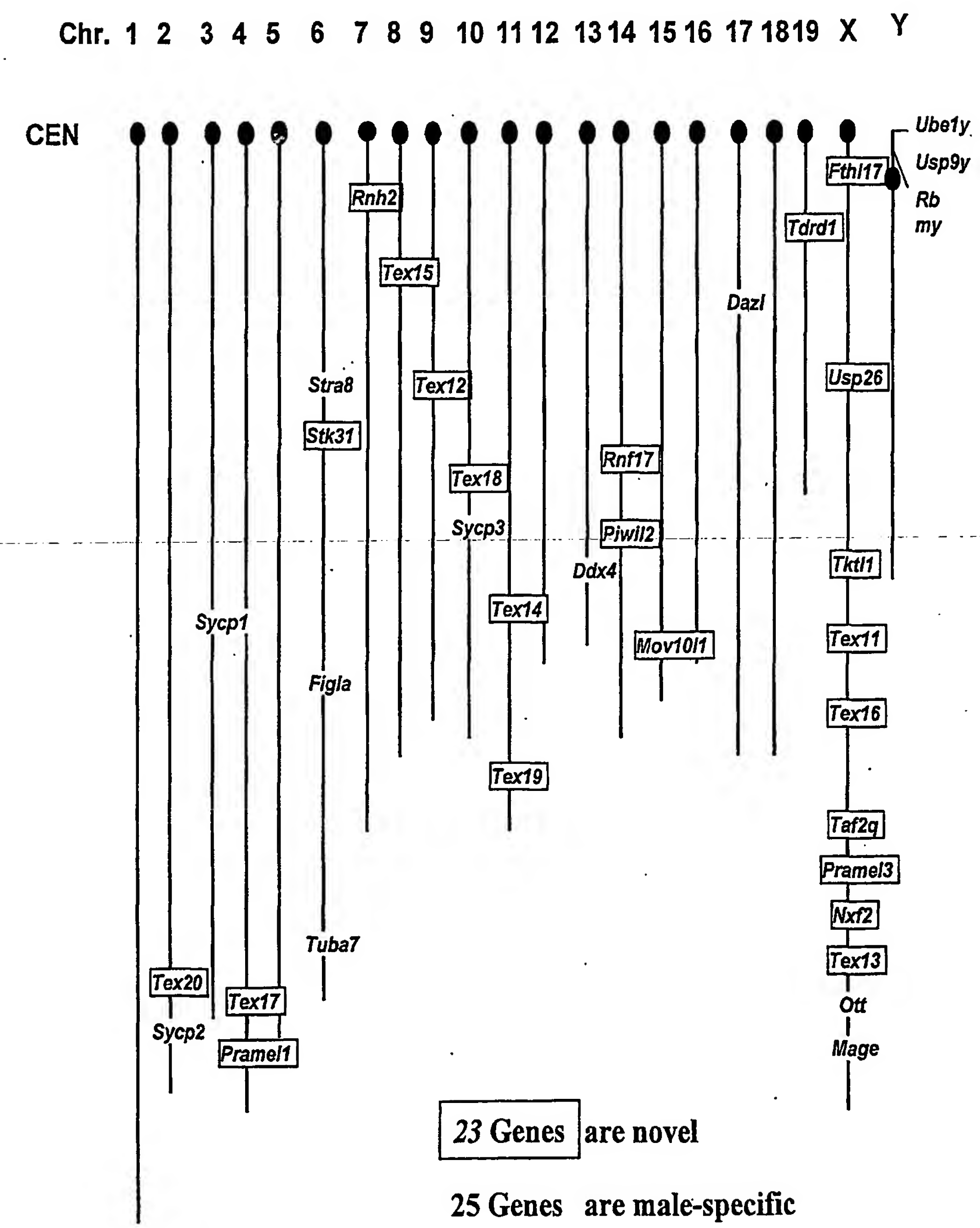
Figure 94

Post-transcriptional gene regulation of germ cell development

Genes	Features
Nxf2	Nuclear mRNA exporter (RRM)
Rnh2	Ribonuclease inhibitor (LRR)
Stk31	One tudor domain
Tdrd1	Four tudor domain
Mov10l1	RNA helicase
Dazl	RNA recognition motif (RRM)
Rbm	RNA recognition motif (RRM)
Ddx4	DEAD box; a putative RNA helicase

Figure 95

Abundance of male germ-cell-specific genes on X Chromosome



$\boxed{23\ \text{Genes}}$ are novel

25 Genes are male-specific

11 Genes are expressed in both sexes

Figure 96

Rapid evolution of spermatogonia-specific genes in mouse and human

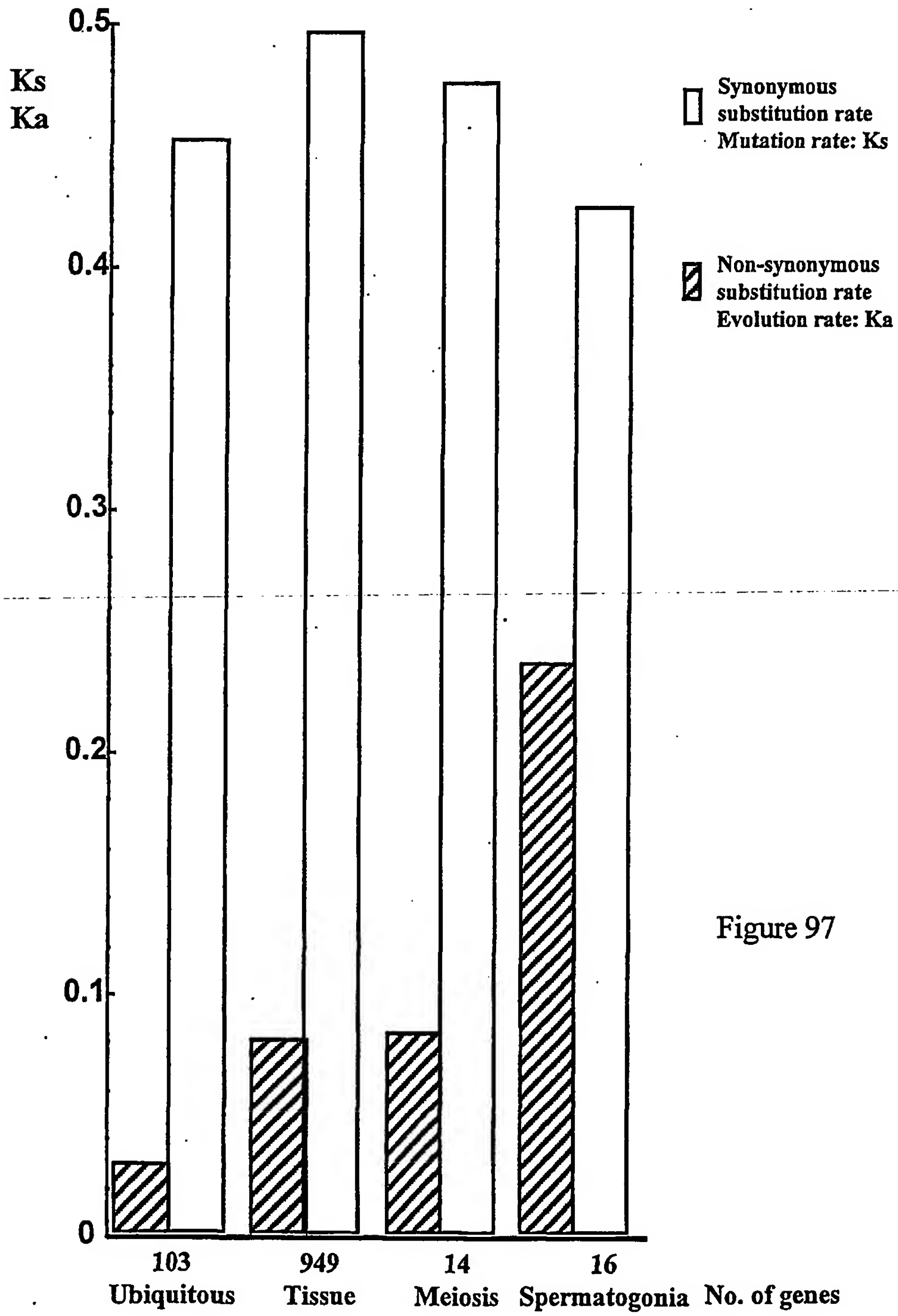


Figure 97

Hybrid male sterility in mice

Locus	*Hst-1*	*Hst-3*
Cross	*M. m. musculus* X *M. m. domesticus*	*M. spretus* X *M. m. domesticus*
Separation	1 million yrs	3 million yrs
Male sterility	Yes	Yes
Mapping	Chr. 17 t-complex	Chr. X distal end
Pathology	meiotic arrest	meiotic arrest
X-Y dissociation	High	High/Low
Autosomal dissociation	High	High/Low
Nature of defect	Genic	Structural ?

Figure 98

Candidate genes for *Hst-3*

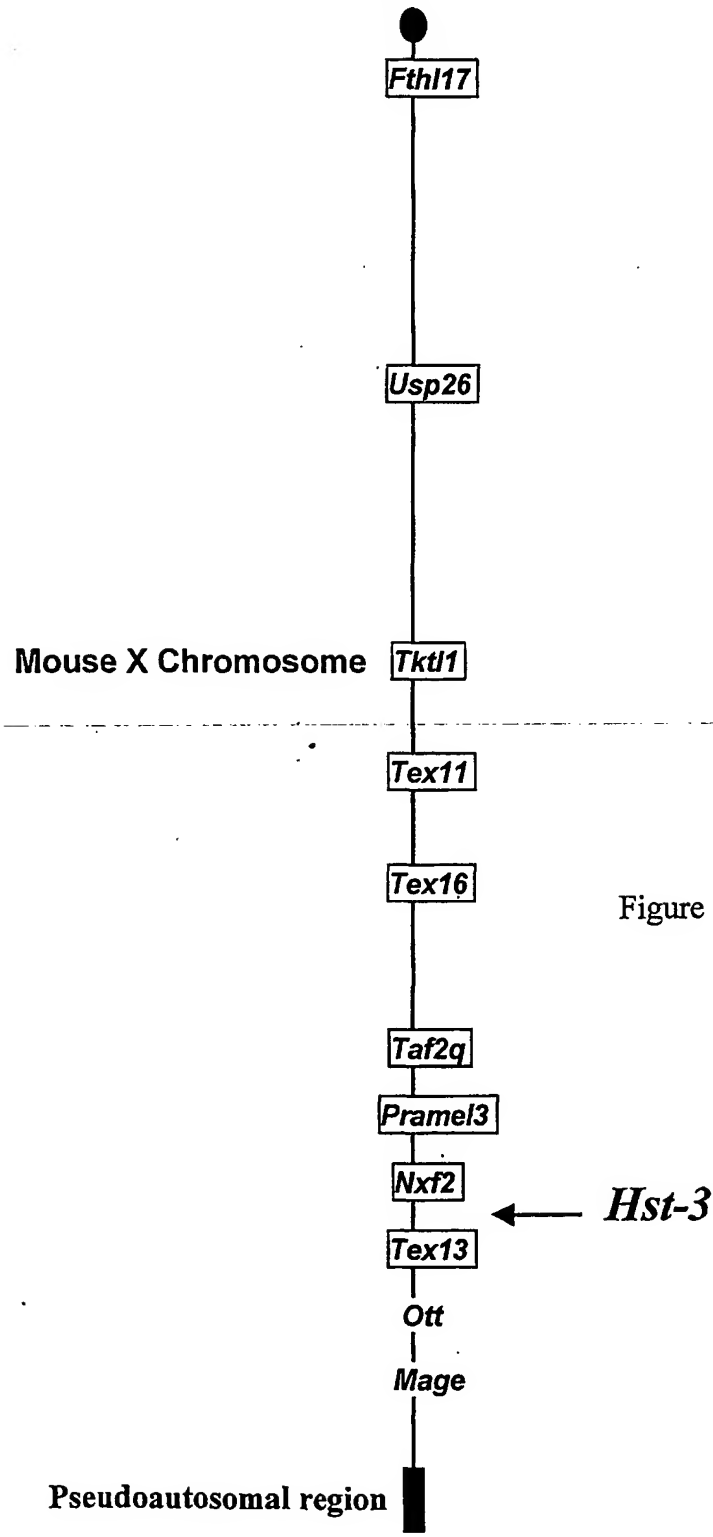
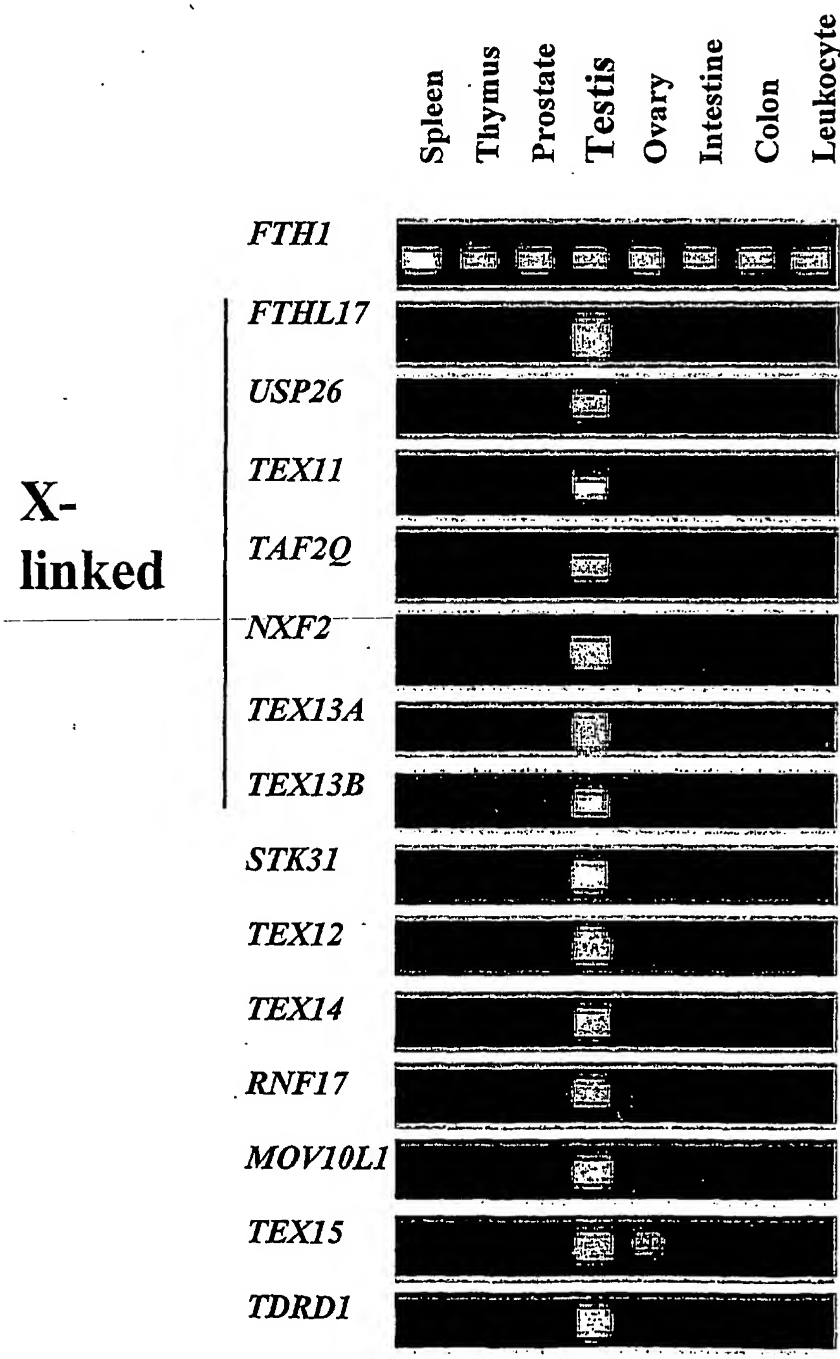


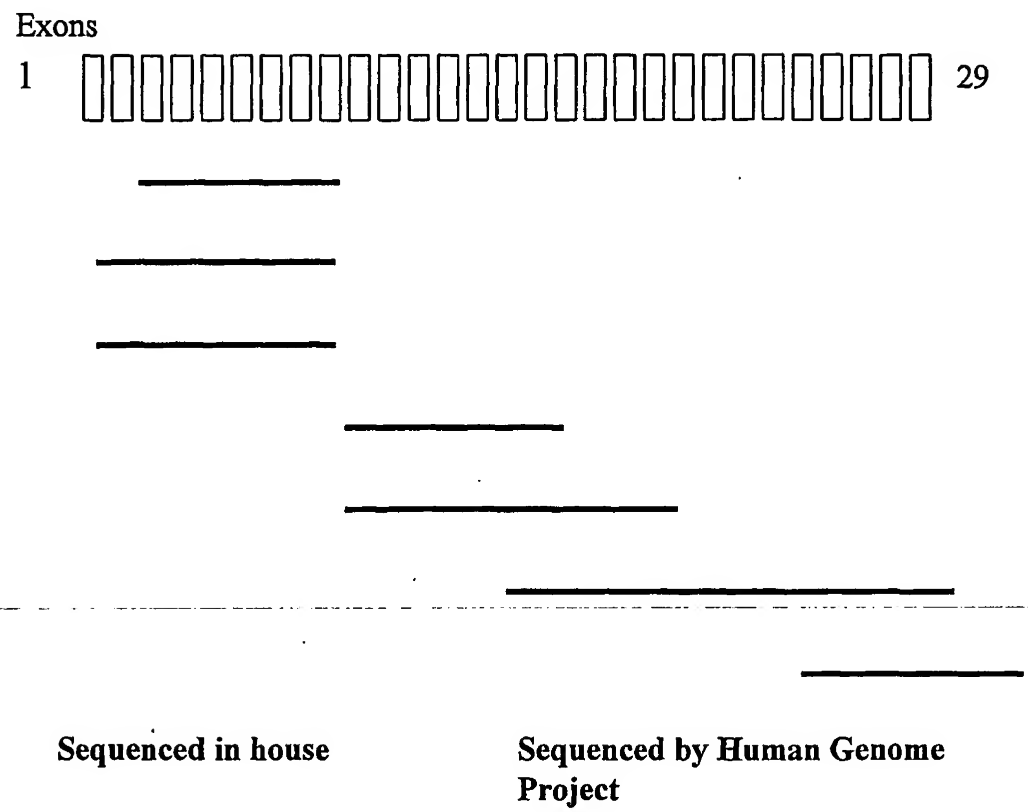
Figure 99

14 novel human testis-specific genes



Figur 100

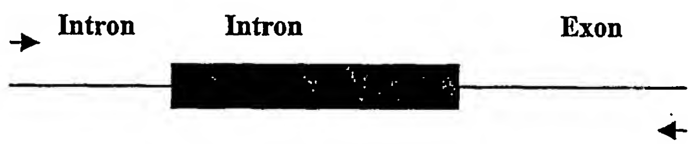
BAC physical map and gene structure of *TEX11*



The *TEX11* gene is ~ 400 kb and consists of 29 exons.

Figure 101

High throughput mutation screening by genomic sequencing



PCR amplification on infertile patient DNA
Sequencing of PCR product
Sequence analysis

380 infertile males and 93 fathers
29 exons of TEX11

14,000 PCR reactions
14,000 sequencing reactions

Figure 102

Mutations found in infertile but not normal males

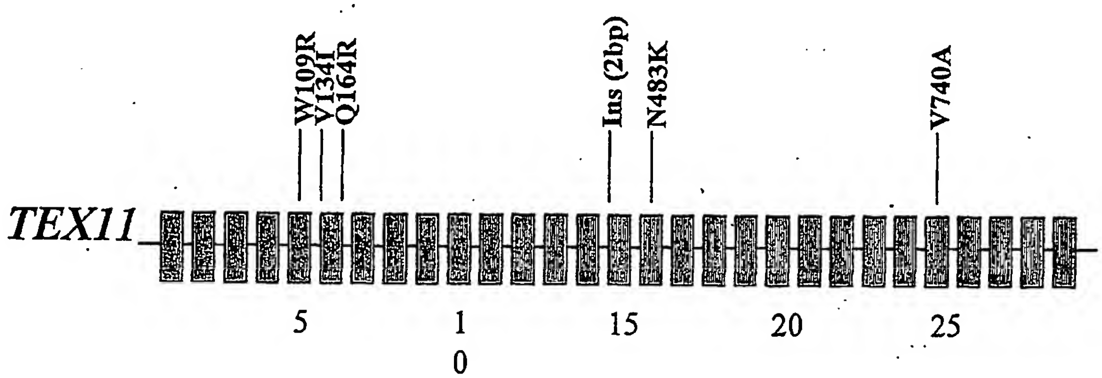


Figure 103

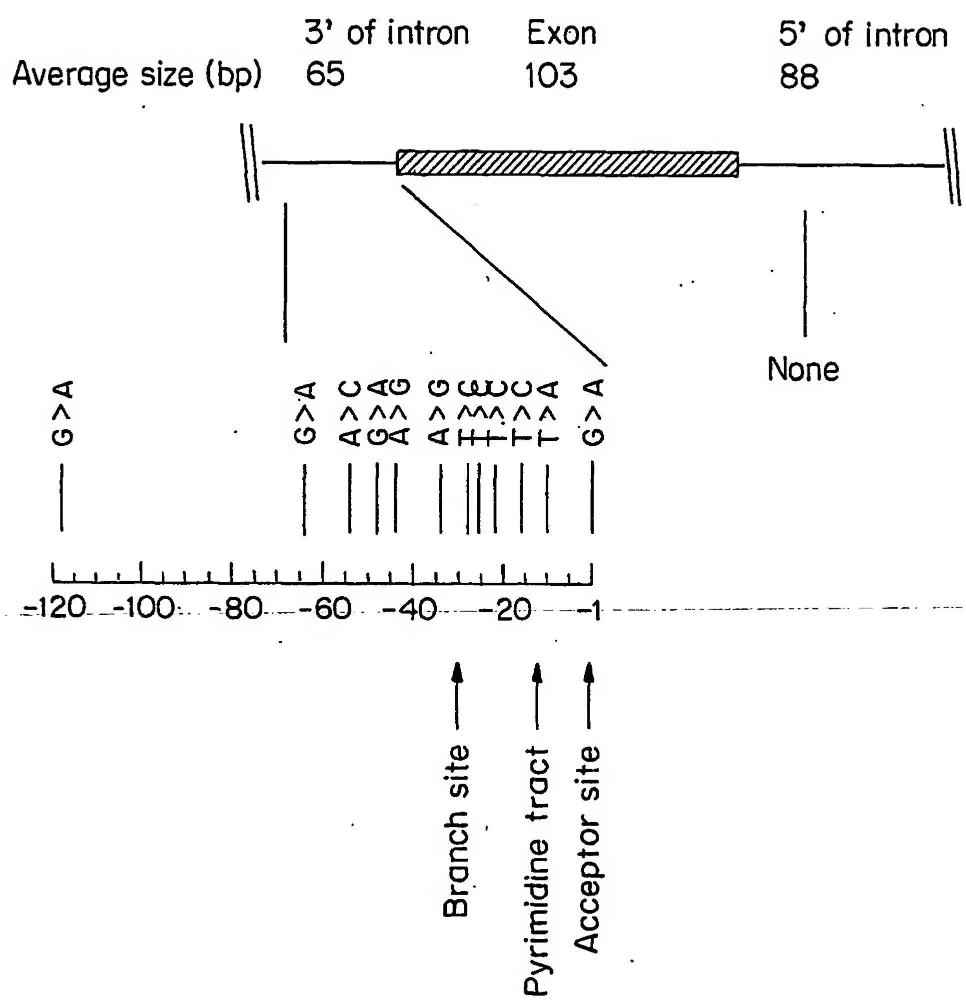

3' of intron
Exon
5' of intron
Average size (bp)
65
103
88
None
G>A
G>A
A>C
G>A
A>G
A>G
T>G
T>C
T>C
T>C
T>A
G>A
-120
-100
-80
-60
-40
-20
-1
Branch site
Pyrimidine tract
Acceptor site

FIG. 104

Epigenetic down-regulation of X-linked genes during male meiosis

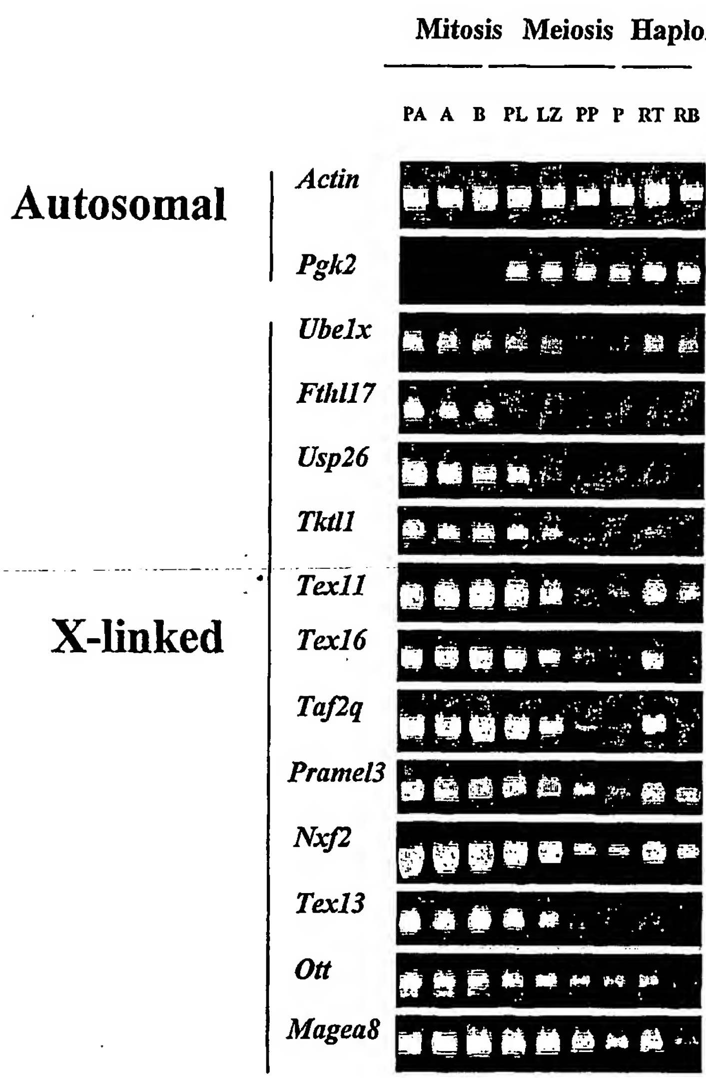


Figure 105

Abundance of spermatogonia genes on X Chromosomes

<u>Origin of Species</u> | <u>Origin of human male infertility</u>

Hybrid sterility | X-linked male infertility

Hybrid sterility in men ?

Figure 106

Intronic Variants in *TEX11*

Patient	IVS	Variant	Diagnosis	Found in 380 infertile	Found in 93 normal
1E03	2	T(-17)C	AZ	1	0
	3	A(35)G		CV	57
	3	T(-22)C	AZ, SCO, TMA	6	0
2H4	3	CAT(-22)TAC		1	1
4F9	4	G(-48)A	SCO	1	0
	10	T(-27)C		CV	5
4F12	11	T(-28)C	TMA	1	0
1C02	14	G(-64)A	SCO/TMA	1	0
	15	A(48)T		CV	22
	17	ATT, AAC GAC -23 to -25		CV, three haplotypes	Yes
1G08	18	T(-22)C	severe OZ	1	0
1C6, 4G11	20*	T(-10)A	AZ, TMA	2	0
4B11	20*	G(-1)A	TMA/OZ	1	0
4G1	21	A(-34)G	SCO	1	0
	22	C(-44)T	normal	0	1
1C2	23	G(-119)A	SCO/TMA	1	0
4C6	26	A(-55)C	SCO	1	0
	27	T58C		12	3
	27	TC(-4,-3)AT		Variant	4
2H9	27	A(-44G)	fructose+ AZ	1	0
	3'UTR	T(123)C		4	1

Only 1 variant found in normal males
All the variants only in infertile males are in the 3' region of introns
Nearly all are in the AZ, TMA, SCO.

Figure 107

CODING VARIANTS IN *TEX 11*

Patient ID	Source	Exon	Variant	Change	Diagnosis	I^{380}	F^{93}
		5	AAA-AGA(320) K107R	mis		14	5
1B12 WHT3150	Oates$	5	TGG-AGG(325) W109R	mis	AZ	1	0
4B04 WHT3171	Oates$	5	C381T next to 5' SS	silent	TMA	1	0
3D12 WHT3417	Oates$	6	GTC-ATC(400) V134I	mis	AZ/OZ	1	0
3G08 WHT3500	Silber$	6	CAA-CGA(491) Q164R	mis	pathologic AZ	1	0
1H11 WHT3759	Silber$	15	Ins(1233) 2bp	nonsense	TMA	1	0
		15	GAA-AAA(1282) Glu428Lys	mis		20	3
2B06 WHT3677	Oates$	16	AAC(1449)AAA Ans483Lys	mis	OZ	1	0
4C04 WHT2499	Silber$	25	GTG2219GCG V740A	mis	TMA	1	0
1B07 WHT3459	Oates$	25	A(2250)T	silent	AZ	1	0
4C06 WHT2546	Silber$	26	T2295C	silent	SCO	1	0
		27	T2472C	silent		23	4

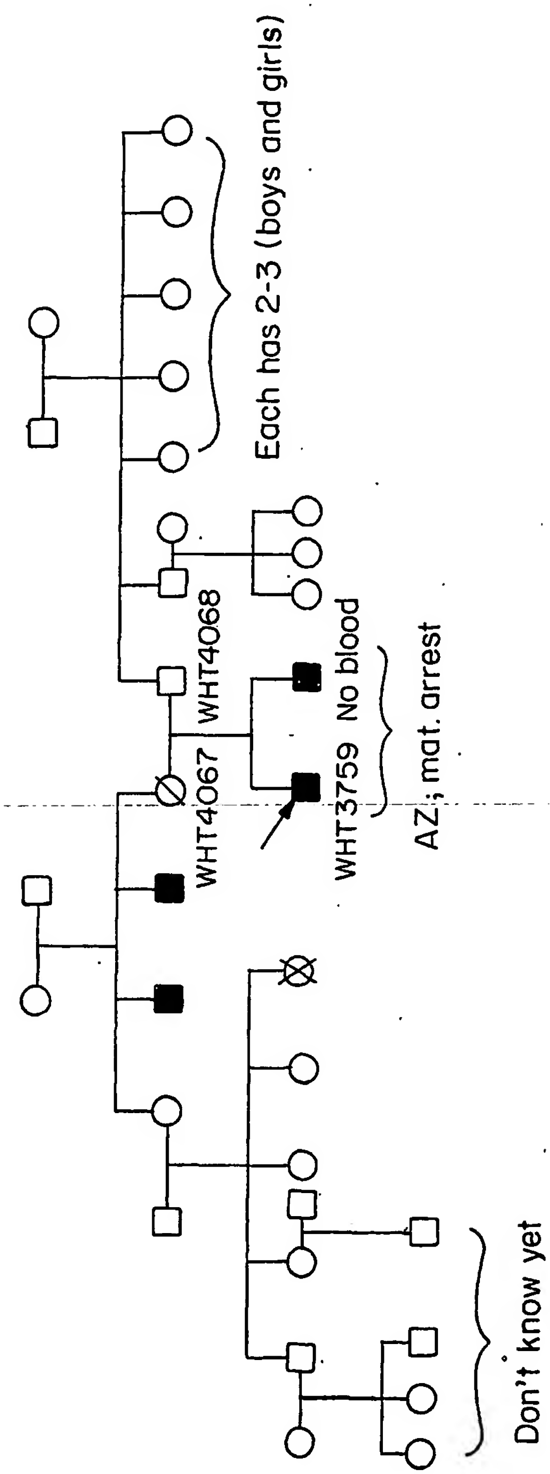
AZ: azoospermia; OZ: oligospermia; TMA: testicular maturation arrest; SCO: sertoli cell only

$ = families being pursued and cell lines being further studied

I^{380} = No. in 380 infertile men

F^{93} = No. in 93 normal men

Figure 108



Both maternal uncles: >30 yrs of marriage and no children

↗ Indicates the proband who has a 2bp insertion in *TEX11*

WHT4067 is heterozygous for this mutation

WHT3759 family tree

FIG. 109

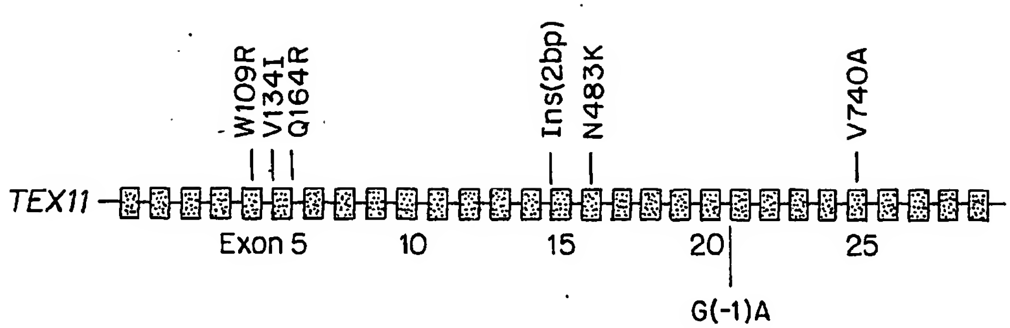
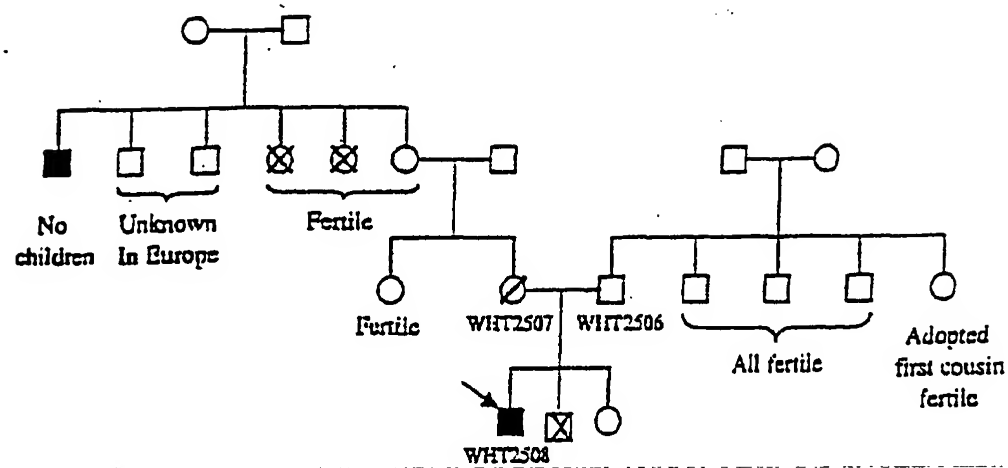


FIG. 110

Coding variants found in infertile but not normal males



AZ; mat. arrest

Proband WHT2508 has on bp deletion in TAF2Q (X-linked).
We have his histology
WHT is heterozygous for this mutation

WHT2508 pedigree

Figure 111

Variants in *TAF2Q*

Patient ID	Source	Exon	Variant	Change	Diag-nosis	I^{380}	F^{93}
3F9 WHT3457		3	T142C 4bp to SS	silent	TMA	1	0
1F11 WHT3493	Oates $	4	GAT-GTT(149) Asp39Gly	mis	OZ	1	0
2B3		5	G375A	silent	severe OZ	1	0
		9	AGC-GGC (664) Ser222Gly	mis		66	11
		10	6bp Del	Del(2 au)		96	20
1A11 WHT2508	Silber $	11	Del (A928)	nonsense	TMA	1	0
Ctrl #1C06		13	G1109A C370Y	missense	Normal	0	1
3C12		IVS2	G(-47)C		OZ	1	0
4E08		IVS3	A(-24)C		SCO	1	0
3E05		IVS4	A(24)C		unknown	1	0
2F10		IVS7	C(-57)G		unknown	1	0
		IVS8	A(52)G			CV	31
1B11		IVS9	G(9)A		AZ	1	0
		IVS10	A(91)G			61+96 (haplotype)	10+20
		IVS10	(-104)			CV	29

I^{380} = No. in 380 infertile men
F^{93} = No. in 93 normal men

Figure 112

Mouse Genes

Gene symbol	Gene name	Ex-pression	Chr	GenBank no.	Comments
Fthl17	Ferritin heavy polypeptide-like 17	testis	X	AF285569	Ferritin, functioning in iron metabolism, consists 24 heavy and light chains[a]
Usp26	Ubiquitin specific protease 26	testis	X	AF285570	Predicted protein contains His and Cys domains conservedamong deubiquitinating enzymes [b]
Tktl1	Transketolase-like 1	testis	X	AF285571	Homologous to human transketolase *TKTL1*[c]
Tex11	Testis expressed gene 11	testis	X	AF285572	Novel 947-residue protein
Tex16	Testis expressed gene 16	testis	X	AF285573	Novel 1139-residue protein; rich in serine
Taf2q	TBP-associated factor, RNA polymerase II, Q	testis	X	AF285574	Human autosomal homolog *TAF2F* encodes a component of TFIID[d]
Pramel3	PRAME (human)-like 3	testis	X	AY004873	Homologous to human *PRAME*, encoding a melanoma antigen recognized by cytotoxic T cells[e]
Nxf2	Nuclear RNA export factor 2	testis	X	AF285575	Homologous to Mex67p and *NXF1*, encoding nuclear RNA export factors [f-h]
Tex13	Testis expressed gene 13	testis	X	AF285576	Novel 186-residue protein; two closely related homologs on human X chromosome
Pramel1	PRAME (human)-like 1	testis	4	AF285578	Homologous to human *PRAME*
Tex17	Testis expressed gene 17	testis	4	AF285579	Novel 120-residue protein; calculated pI 9.9
Stk31	Serine/threonine kinase 31	testis	6	AF285580	Putative protein kinase [i] with tudor domain (found in RNA-interacting proteins)[j] and coiled coil region
Rnh2	Ribonuclease inhibitor 2	testis	7	AF285581	Predicted protein contains 6 leucine-rich repeats[k]
Tex12	Testis expressed gene 12	testis	9	AF285582	Novel 123-residue protein with coiled coil region
Tex18	Testis expressed gene 18	testis	10	AF285583	Novel 80-residue protein
Tex14	Testis expressed gene 14	testis	11	AF285584	Predicted protein contains two protein kinase domains[i]
Rnf17	Ring finger protein 17	testis	14	AF285585	A RING finger-containing protein[l]
Piwil2	piwi (drosophila)-like 2	testis	14	AF285586	Homologous to *Drosophila piwi*, involved in germ-line stem cell renewal and meiotic drive [m,n]
Mov10l1	Mov10 (mouse)-like 1	testis	15	AF285587	Putative RNA helicase[o]

Figure 113a

Gene symbol	Gene name	Ex-pression	Chr	GenBank no.	Comments
Tex20	Testis expressed gene 20	testis and ovary	2	AF285588	Novel 188-residue protein; calculated pI 10.2
Tex15	Testis expressed gene 15	testis and ovary	8	AF285589	Novel 2785-residue protein
Tex19	Testis expressed gene 19	testis and ovary	11	AF285590	Novel 351-residue protein with coiled coil region
Tdrd1	Tudor domain protein 1	testis and ovary	19	AF285591	Predicted protein contains 4 tudor domains[j]

a Lawson, D.M. *et al., Nature* 349, 541-544 (1991).

b Baker, R.T., *et al., J. Biol. Chem.* 267, 23364-23375 (1992).

c Coy, J.F. *et al.,Genomics* 32, 309-316 (1996).

d Chiang, C.M. & Roeder, R.G. *Science* 267, 531-536 (1995).

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Figure 113b

Mouse spermatogonially expressed gem specific gene and the human orthologs

Mouse	Gen Bank No.	Human	GenBank No.	Chr.
Fthl17	AF285569	*FTHL17*	AF285592	X
Usp26	AF285570	*USP26*	AF285593	X
Tktl1	AF285571			
Tex11	AF285572	*TEX11*	AF285594	X
Tex16	AF285573			
Taf2q	AF285574	*TAF2Q*	AF285595	X
Pramel3	AY004873			
Nxf2	AF285575	*NXF2*	AF285596	X
Tex13	AF285576	*TEX13A*	AF285597	X
Pramel1	AF285578	*TEX13B*	AF285598	X
Tex17	AF285579			
Stk31	AF285580	*STK31*	AF285599	7
Rnh2	AF285581			
Tex12	AF285582	*TEX12*	AF285600	11
Tex18	AF285583			
Tex14	AF285584	*TEX14*	AF285601	17
Rnf17	AF285585	*RNF17*	AF285602 AF285603	13
Piwil2	AF285586			
Mov10l1	AF285587	*MOV10L1*	AF285604	22
Tex20	AF285588			8
Tex15	AF285589	*TEX15*	AF285605	
Tex19	AF285590			10
Tdrd1	AF285591	*TDRD1*	AF285606	

Figure 113c